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PHILADELPHIA OFFICE, - - - - - - - - - 929 Chestnut Street.

EUROPEAN OFFICE, - - - - - - - - - - A. C. Shaw, Manager.
Hastings House, Norfolk St., Strand, London, England.

T. C. MARTIN AND W. D. WEAVER, - - - - - - - - - - Editors.
T. R. TALTAVALL, - - - - - - - - - - - - Associate Editor.

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ONE CENT A CALL.

It is stated that capitalists in Elizabeth, New Jersey, are proposing to establish a telephone system there upon the basis of one cent per call, telephones being also installed free, with wires laid underground, which, of course, means also metallic circuits. This sounds like a telephone millenium, and we do not know that it has been realized on such terms in any American city yet. We should dislike to dampen the ardor and enthusiasm of the promoters, but must confess we can see no money for anybody in the plan. Elizabeth, not a large place, has two telephone systems now, and a third would find it "hard sledding," although at such bottom prices it might in the long run drive its competitors into bankruptcy, only to follow them there itself shortly after. Cheap telephony is a desideratum, and telephoning is already pretty cheap, but it is not to be inferred, as some people are doing, that because such plans are projected at Elizabeth they are either valid or if valid there good for general adoption. It is interesting to note the recognition in all recent telephone development of the measured rate basis of operation as compared with the old flat rate still prevalent in many quarters.

WIRELESS TELEGRAPHY.

One of the most important events of this week has been the conclusion of an agreement between Mr. Marconi and the Canadian Government for the establishment of a wireless telegraph system between the Dominion and Great Britain. Reference has already been made in some detail to this contract in our pages, the main point being a rate of 10 cents per word, whereas the existing cable rate is 25 cents; and the press rate is to be 5 cents. Some other features of the contract we shall have occasion to note and comment on later; but our object just now is to emphasize the tremendous fact that such a contract has been entered into at all. It implies on both sides a serious intention, and a serious confidence in the thorough feasibility of the enterprise. The immediate future is therefore full of interest, both as to what may directly attend the execution of the Marconi plans, and as to what the effect will be on cable rates and cable improvement. The only thing to be hoped for is that while existing rights may be fully protected, there will be no stupid governmental interference in England to check progress in this momentous development.

AUXILIARY FIRE ALARMS

Readers of the New York daily journals will have become familiar recently with the fact that there is a sharp controversy in progress as to the use of auxiliary fire alarm systems, the new heads of the Fire Department being opposed apparently to such service. It is not our desire or intention to intervene in the discussion, except to express our fervent hope that no reduction of this useful service will be permitted. After the recent series of terrible fires in New York, a sense of insecurity prevails as to the real safety of alleged fireproof hotels and other buildings, and it would be nothing short of a crime to lessen at this juncture, or, indeed, at any other time the protections and precautions that are thus thrown around life and property. These auxiliary systems are based upon a connection from the building to the nearest street box, and it is evident that in case of danger, the response of the nearest fire brigade must be materially expedited. To quote Mr. W. F. Allen, president of the system at which the movement appears primarily directed: "The enormous expense of installing and maintaining independent trunk-line systems covering the entire city would be so great that the service could not be

supplied at prices which the customers would be able or willing to pay. Absolutely the only way in which interior fire alarm service, so greatly needed, can be made available in every settled section of the city is through connections with street boxes, such as we are providing. It seems to us manifestly absurd that a fire-alarm system of recognized value should be interfered with because at this time it is the only system which is capable of meeting certain requirements. It also seems to us that it would be equally unreasonable to say that people in sections remote from trunk-line service should be obliged to go without fire-alarm service, or pay extravagant prices for trunk-line service, when the usefulness of the street boxes can be indefinitely multiplied through our well-known and approved form of service available everywhere at moderate cost, and without ever interfering with or injuring the public fire-alarm service. What we do is to allow citizens and taxpayers to operate a street box from the interior of their premises, and at their own cost. In other words, we enable a citizen to do from a distance precisely what he has a right to do at the street box itself, but with a saving of extremely valuable time."

This puts the case in a nutshell, and we can hardly believe that public opinion will tolerate any interference with so valuable an auxiliary. This is one of the modern methods of safety or of added convenience that the public owes to electricity, and its use should be widened and extended rather than curtailed. Moreover, aside from the additional protection it furnishes the citizen, it renders the fire service so much more efficient and flexible, enabling it with less expense and effort to reach a fire and quench it at the very start.

THE METRIC SYSTEM.

The Committee of Coinage, Weights and Measures of the House of Representatives has reported favorably the bill establishing the metric system as the legal standard of weights and measures in the United States, and requiring all Government Departments to use only that system, except in completing the survey of the public lands. This report was only rendered after a series of public hearings, at which opponents as well as friends of the system gave testimony, and that there were but two members of the committee of seventeen who cast dissenting votes, augurs well for the final success of the measure. In the same issue of the *New York Herald* which contained an announcement of the action of the committee, appeared a cable despatch stating that at the annual conference last week of the Associated Chambers of Commerce of Great Britain and Ireland, a resolution was adopted almost unanimously in favor of the metric system. In a recent issue we referred in general terms to the strong support that has been enlisted in favor of the metric system in the British Parliament. We have now before us a list of 259 names of members of the House of Parliament who have notified their approval of the adoption of the metric system for Great Britain. In addition, 30 members have signified their approval but withhold authority to publish their names. Some indication of the present strong trend of opinion in Great Britain is given by the fact that since Jan. 30, 31 members of Parliament have signified their approval of the system. The movement in favor of the metric system has undoubtedly gained enormously in strength in Great Britain during the past several years, and the time for definite action there in its favor appears to be almost ripe. As the adoption of the system by either country will inevitably force its adoption in the other, we sincerely hope that Congress at the present session will pass the bill now before it and thereby reserve to this country the credit of initiative in the great reform.

A committee of the American Society of Mechanical Engineers in a circular urges that members of that society address their Representatives in Congress protesting against the passage of the metric system bill, on the grounds that if the bill is passed it will make our present systems of weights and measures illegal. We must express surprise that such a statement should be put forth with the authority of the Society of Mechanical Engineers. As we pointed out in a recent issue, the bill in question seeks to make the use of the metric system compulsory only in the United States Government Departments and offices, and that, "In this land of liberty no man can be restrained from either measuring or stating the height of his horse in 'hands,' or areas of his barn in 'poles' as long as it shall please him so to do." This view has since been confirmed by Attorney-General Knox, who was asked for an opinion as to whether the bill would invalidate contracts made after it took effect, in which the weight or measure provided for should be expressed in terms other than those of the metric system. The opinion states that the bill does not compel people to use only the metric system, or prohibit them from the use of any other, and that it would not make invalid contracts expressed in other terms. Moreover, there has never been a time when a contract expressed as to weight or measure in terms of the metric system or any other system would not have been just as valid as if expressed in the terms in common use. Attorney-General Knox concludes by saying that he does not think it would be within the competency of Congress to forbid to the people the use of any system of weights or measures.

ELECTRIC SHOCK.

A meeting of the British Institution of Electrical Engineers last month appears to have been devoted to the consideration of papers on electric shocks, and three good papers on the subject were read. They were written by engineers for engineers, and set forth many of the important engineering facts and experiences that have been accumulated during a fairly long history of electrical applications. Unfortunately, however, the physiological and medical sides of the question do not seem to have been brought forward, and no treatment of the subject of electric shocks can be complete in any sense without taking the medical and physiological aspects into consideration. One of the writers described a number of valuable observations in connection with shocks, and absence of shocks, from trolley wires and trolley rails. According to Mr. Trotter, sensation, in connection with feeble shocks, is largely a matter of current-density; while the effects of more powerful shocks are mainly dependent on the total current-strength. He considers one or two milliamperes to be hardly perceptible, from 3 to 8 milliamperes readily supportable; while he sets the limits of endurance at 35 milliamperes. In this generalization we entirely concur, with sole reference, of course, to the ordinary superficially applied currents, such as may occur in accidental shocks.

It was generally admitted that pressures below 600 volts are very unlikely to produce fatal shocks; while the danger increases rapidly above 1000 volts. Of course, no rigid rule can be laid down; because, assuming that all persons are equally susceptible, which is unlikely, the degree of danger would depend both upon the path of the current through the body, and upon the strength of the current. The current-strength, in turn, depends both on the voltage, and upon the resistance in the path. A great mass of evidence has been collected concerning the electric resistance offered by the human body under different conditions, and the conclusion appears to be that it is capable of enormous variation according to the positions, surface-areas, and wetness of the electrodes. In electrocutions the resistance of the body is intentionally reduced to about two hundred ohms, by the application of large electrodes, thoroughly wetted with saline solution. Between dry finger-tips, on opposite hands, however, the resistance may be many thousands of ohms. The same applied voltage will tend to produce corresponding inverse current strengths in the two cases. Remarkable suggestions were made that the susceptibility to shock may be diminished by drunkenness, sleep, and weakness of intellect;

while it may, perhaps, be increased by kidney-disease. Such suggestions should be carefully examined in the light of future evidence.

The whole subject of electric shock calls for further physiological investigation. According to recent researches of Dr. Cunningham, death by the ordinary electric shock, when not caused by burning, is due to fibrillar contractions in the heart, or a state of abnormal muscular action in that organ, in which the normal functions are suspended, and the circulation stops. The researches which led to his conclusions were conducted upon dogs. It seems very important to have this conclusion verified, and researches instituted looking for a method of procedure which shall aid the fluttered heart in resuming its functions. According to some, while artificial respiration should be applied in all cases, yet it offers but little hope when the heart is seriously thrown into fibrillar contractions, and what is wanted is some means of applying corrective stimulus to the heart, to make it resume its normal muscular action. Assuming that this is the correct view of the matter, any means that might be experimentally discovered, of stimulating the heart of a person in suspended animation through electric shock, would be very valuable to the world of electric workers. We want to be told just what the physiological dangers are, and just what course to pursue when medical attendance is not at hand. Some curious views were presented bordering on the physiological question, such as the view that the conditions which produce a burn in electric shock, tend to reduce the danger of fatal consequences. Such opinions, it would seem, can only be supported by a great deal of testimony.

A NOTABLE POWER TRANSMISSION.

In these days of high voltage and long distance lines it takes something quite out of the ordinary to attract any considerable amount of attention or to merit especial attention. Only engineering features of especial interest enable a new plant to rise above the level of the commonplace. The great Mexican plant which we are describing in current issues, however, deserves more than passing consideration. Its first notable feature is the very unusual character of the hydraulic development. Briefly, the situation was as follows: Having as an objective point the City of Mexico, plenty of water was available, but not enough at any one point to supply the total amount necessary. Ordinarily the practice is to gather sufficient water, by long canals if necessary, to operate a single large power-house, but in this instance the practicable falls, five in number, were scattered over a considerable area and were located on two streams. The country was difficult for canals or flumes, and on the whole the cheapest way out of the difficulty seemed to be the installation of a small separate station at each fall, the total summation of the energy being electric instead of hydraulic. The situation somewhat recalls that on the Gorzente near Genoa, but while in that case there were but three stations operated independently, in this instance there are five power stations operated together. Obviously, the attendance required in such a group of stations is much larger than it would be if the ordinary practice were followed, but the sub-division was required by the hydraulic situation. Even so the hydraulic operations were none too easy. A rather singular feature is the use of masonry aqueducts in short runs over ravines. In common American practice wooden flumes would be used in similar situations, but conditions are somewhat different on the Mexican plateau and the use of masonry was doubtless justified.

With five generating stations small units were in order, and the size taken as standard was 225 kilowatts, which facilitated transportation, always a tough problem in a wild country. The periodicity chosen was 50 cycles, an excellent compromise frequency, but rather unusual in this country. If we remember aright, outside of the great network around Los Angeles, 50 cycles are used in only three or four American plants. The voltage, 22,000, is in line with the best recent practice and may now be considered as rather conservative than otherwise. The whole system is worked in multiple with the utmost freedom whenever convenient, the entire nineteen generators being sometimes thrown together. In this connection it seems odd that common practice so persistently adheres to synchronizing with the phase-lamps dark. The reverse connection, synchronizing with the lamps bright, is both more sensitive if the lamps are arranged for a low maximum brilliancy, and safer, as a lamp may burn out during synchronizing. Such an accident seems rather unlikely, but it has actually happened. By way of emphasizing the ease with which modern polyphase machines are operated in multiple the interesting condition is sometimes reached when a steam-driven generator at the principal sub-station near the City of Mexico is worked in multiple with the whole complex system. One unusual feature noted in the switchboard plans is the use of fuses between the generators and the bus bars. Of course, such a precaution is hardly needed to protect the generators, but there certainly is an advantage in having protection between the machines and the switchboard, so that in case of the short circuits that are not anticipated but do occur, a costly switchboard may not be utterly wrecked before the wheels can be shut down. The free use of wattmeters in the station equipment of these plants is specially to be commended. Far too many American plants are without them or are very inadequately supplied.

The main transmission lines themselves are unusual in that metal poles are used and the wire is "weather proof." The former point of variance may be necessary on account of the climate and the depredations of insects, but of what imaginable use on a 22,000-volt line weather-proof wire can be is beyond our comprehension. And the pole situation is difficult to understand, from the fact that the double pole line from the City of Mexico about half way to the generating stations is of redwood poles. An unique feature of the main substation is the use of a storage battery with a reversible rotary converter, which involves some very pretty problems in regulation of the voltage when running reversed. The distribution of energy for lighting and power in the City of Mexico involves some unusual features. The primary voltage of 2600 is the highest working potential for a large distribution with which we are acquainted, save in one of two instances in which a four-wire three-phase primary system has been used with 2200 volts or so between the phase wires and the neutral. Moreover, in the Mexican case part of this primary distribution is underground. The secondary distribution is likewise rather unusual—a two-phase system worked at 240 volts for motors and with a fifth wire converting the lighting system into an ordinary alternating current three-wire system at 120 volts on a side. It sounds a bit intricate, but much would depend in practice on the kind and amount of motor service, so that it may work out more simply than seems possible at first sight. The distribution is mainly from good-sized transformer units, and altogether it seems a particularly fine example of a pure two-phase distribution. The whole system strikes one as remarkably facile in the adaptation of means to ends. This is perhaps the strongest point of American engineering—the "get there" gait which is taken under all sorts of adverse conditions. Very few transmission plants have faced a combination of circumstances more peculiar than this one, but it has no terrors for the engineers, and the result speaks for itself. It is a plant peculiarly worth attentive study, by reason of its importance as well as on account of its unusual features. No two transmission plants are alike; each presents a new set of problems for solution and requires a treatment peculiar to itself. The art of the skillful engineer lies largely in his power to meet new conditions as they arise and to bend the means at hand to their treatment.

American Institute of Electrical Engineers Endorses the Metric System.

At the February meeting of the Council of the American Institute of Electrical Engineers, the following resolution, reported by the Committee on Standardization, was unanimously accepted and adopted:

Whereas, the metric system of weights and measures offers very great advantages by its simplicity, consistency and convenience in every-day use, as well as in all engineering calculations and computations, and

Whereas, these advantages have already been demonstrated by the universal adoption and entirely successful use of the metric system in all civilized countries except Great Britain and the United States. and

Whereas, all the electrical units in universal use, such as the volt, ampere, ohm, watt, etc., are metric units, and

Whereas, the industrial use of these electrical units would be much facilitated by the general adoption of the metric system,

Resolved, that this committee unanimously recommends the introduction of the metric system into general use in the United States at as early a date as possible without undue hardship to the industrial interests involved.

Resolved, that this committee favors such legislation by Congress as shall secure the adoption of the metric system by each department of the National Government as speedily as may be consistent with the public welfare.

Electrical Engineers of the Day—XXXVIII.

EDWARD G. ACHESON.

Edward Goodrich Acheson was born March 9, 1856, in Washington, Pa., and secured his early education in that town. The expectation of a college career was frustrated by the death of his father and ensuing financial difficulties connected with the family estate, and at the age of 17 the youth was left to shift for himself. For a period of seven years, or until he was about 24 years old, he was employed principally in civil engineering connected with railroad work.

During the early part of the year 1880 he became greatly interested in the developments then occurring in the electrical field, principally through a close following of the work of Thomas A. Edison at Menlo Park, as outlined in the technical and daily papers of the time, and in September of that year went to New York. Up to this time Mr. Acheson had never been East or to New York, nor did he have a friend or an acquaintance in the metropolis or in the electrical field. His attempts to secure work with the leading companies of the time were unsuccessful, and finally he ventured to Menlo Park, depressed with doubt as to his ability to secure employment in Edison's laboratory. To his great pleasure, however, Mr. Edison's superintendent engaged him as an assistant draughtsman, his success thus being due to experience gained in civil engineering.

It was on Sept. 12, 1880, that Mr. Acheson commenced work at Menlo Park. He took great interest in the experimental work in progress in the laboratory, and that Mr. Edison appreciated Mr. Acheson's capabilities is indicated by the fact that within two months he was in charge of original experimental work in the laboratory. Under the personal direction of Mr. Edison, Mr. Acheson had learned the several details of the manufacture of incandescent lamps and the methods of installation as then practiced, and this led to his being selected for work in Europe, so that on July 20, 1881, he sailed from New York as first assistant engineer of the Edison interests abroad, and for service in connection with the Edison exhibit at the Paris Electrical Exposition, where he also did some official work.

At the close of the Exposition Mr. Acheson was given charge of the installation of the lamp factory as part of the Edison works at Ivry-sur-Seine. Following this he went on a tour of other European countries installing exhibit lamps. In this capacity he installed the first incandescent lamps in Belgium, Holland and Italy, Edison companies being formed as a result. He returned in 1884 and in 1886 he became associated with the Standard Underground Cable Company as electrician, leaving this company in 1889 to engage once more in private experimental work on the direct conversion of heat into electric energy. After a few months of experimenting, in order to obtain better facilities, he organized a local electric light company for Monongahela City, Pa., which commenced operations Nov. 20, 1890. His experiments on heat conversion were, however, unsuccessful, leaving Mr. Acheson in a frame of mind disposed to welcome a means of retrieving his fortune and gratifying his ambition.

It was then that he recalled to mind the results of an experiment made in Edison's laboratory in the fall of 1880, when an extremely hard material had been produced. It was this that led him to undertake experiments to make an artificial abrasive, the result being that he discovered carborundum in March, 1891. In the latter part of the summer of 1891 he organized the Carborundum Company, and business was commenced at Monongahela City, where it was conducted until the fall of 1895, when the works were removed to Niagara Falls. The importance of this discovery of Mr. Acheson's to the industrial world is best illustrated by the fact that the first sale of carborundum was 200 carats at 30 cents per carat, or about $560 per pound, while last year the plant produced 3,838,000 lbs., which sold at an average price of 10 cents per pound. To-day corborundum is used in all the industrial countries of the world.

While Mr. Acheson was developing the details of the manufacture of carborundum he observed occasional formations of a fine grade of graphite. Appreciating the possibilities involved, he took out a series of patents protecting the method of manufacture, and in 1897 he began the active development of the artificial manufacture of graphite. He organized a stock company under the name of the Acheson Graphite Company in 1900, and later organized a second company under the name of the International Acheson Graphite Company, the latter

absorbing the former. The first commercial manufacture of artificial graphite was in 1897, with a total production of 162,382 lbs. Last year the plant at Niagara Falls produced 1,436,900 lbs., the market extending to all European countries and to Japan. Mr. Acheson's patents embrace methods and processes for making graphite articles, such as electrodes for electro-metallurgical and electro-chemical work, and the production of graphite in bulk as grains or powders.

Mr. Acheson has contributed a number of papers to technical journals, and has read papers before the American Institute of Electrical Engineers, and the Franklin Institute of Philadelphia. He is a member of both of the above-named bodies, as well as of the American Association for the Advancement of Science. He has received two John Scott medals from the Franklin Institute, one for carborundum, the other for graphite; a medal from the World's Columbian Exposition for carborundum; a gold medal from the Trans-Continental Exposition of Omaha for a joint exhibit of carborundum and graphite, and a gold medal for a joint exhibit at the Pan-American Exposition, Buffalo. He also received a grand prix from the 1900 Paris Exposition for his personal exhibit of carborundum and graphite. The gratifying feature of the recognition given Mr. Acheson by the eminent jury of the last-mentioned exposition is found in the fact that Henri Moissan and Messrs. Borchers and Street were members of the jury that awarded the prize. At the dinner given to Prince Henry of Prussia, Feb. 26, at Sherry's, New York, Mr. Acheson was numbered among the 100 Captains of Industry invited to meet his Royal Highness.

The Transmission System of the Compania Explotadora De San Ildefonso of the City of Mexico—II.

BY STEPHEN Q. HAYES.

TRANSMISSION LINES AND ATTACHMENTS.

ALL of the 20,000-volt, high-tension transmission lines are protected by means of Westinghouse Lightning arresters, shown in Figs. 20-22. This part of the installation was very carefully planned, owing to the number and violence of the electric discharges during the rainy season, lasting four or five months of the year.

For circuits of more than 15,000 volts the arrester is mounted upon a marble panel. The non-arcing metal cylinders are held in porcelain holders on the front of the marble and the choke coils are mounted upon the back, being secured to marble partitions supported from the upper part of the panel. This construction is handsome in appearance, affords high insulating qualities, and is fireproof. The connections of the choke coils and non-arcing cylinders that go to make up this arrester are similar to those shown in Fig. 22, which illustrates a 15,000-volt, three-phase circuit.

The two three-wire transmission lines running to Madin from the power houses along the Monte Alto River and the Tlalnepantla River are supported on metal poles 29 ft. high, made in three sections of, respectively, 5, 4 and 3 inches diameter. The weight of these poles is 385 lbs. They are stationed 130 ft. apart, and are planted 5 ft. directly in the earth without the necessity of masonry. Those that are placed in the damp valleys are encased in a cylindrical block of hydraulic cement, 2 ft. in diameter and 6½ ft. deep.

The wires are placed on two wooden cross arms on a summit of two equilateral triangles 2 ft. on the side symmetrically placed with reference to the axis of the poles. These cross-arms are fixed to the poles by means of U-shaped bridles, which present to the pole a large surface of contact. The supports of the insulators are eucalyptus wood pins boiled in paraffine. The insulators themselves are triple petticoat insulators, such as in Feg. 23, which have been tested to 40,000 volts before being placed in position; and the wires of the line are covered with a weather-proof composition. The two three-wire lines running from Madin to the City of Mexico, which transmit the entire output of the power stations, were to have been placed like these foregoing ones on the same pole. But several insulators, mischievously broken at the time of erection, showed the advisability of having the two lines entirely distinct and a new pole line was built. The poles are of Texas red wood, 32 ft. in height, of which sections at the bottom and top are squares, respectively, 9 and 5 inches on the side.

The diverging point of the two pole lines is indicated in Fig. 24. The three wires of the existing transmission lines were transferred in sections and placed on the wooden poles, at the vertices of equilateral triangles 2 ft. on a side. One of the wires is carried at the top of the poles by means of a glass triple petticoat insulator of the type employed with success on the 40,000-volt Provo transmission line. This insulator, shown in Fig. 25, is supported by a eucalyptus wood pin 9 inches high, boiled in paraffine. The other two wires are placed in the same way on a wooden cross-arm 31 inches long. The new transmission line from Madin to the City of Mexico is 10 miles long, while the old one was 8¾ miles. As the action of the reverse circuit breakers in the City of Mexico depends to a certain extent on the resistance of the two lines, it was necessary to use a larger wire on the new line than on the old one.

The high-tension junction switchboard at Madin, with its unique arrangement of wattmeters and synchronizing apparatus, is of particular interest. It will be noticed (Fig. 26) that either or both of the lines from the Monte Alto River, as well as either or both of the lines from the Tlalnepantla, can be connected with either or both of the lines running to the City of Mexico. The method of synchronizing these various lines before throwing them together is similar to

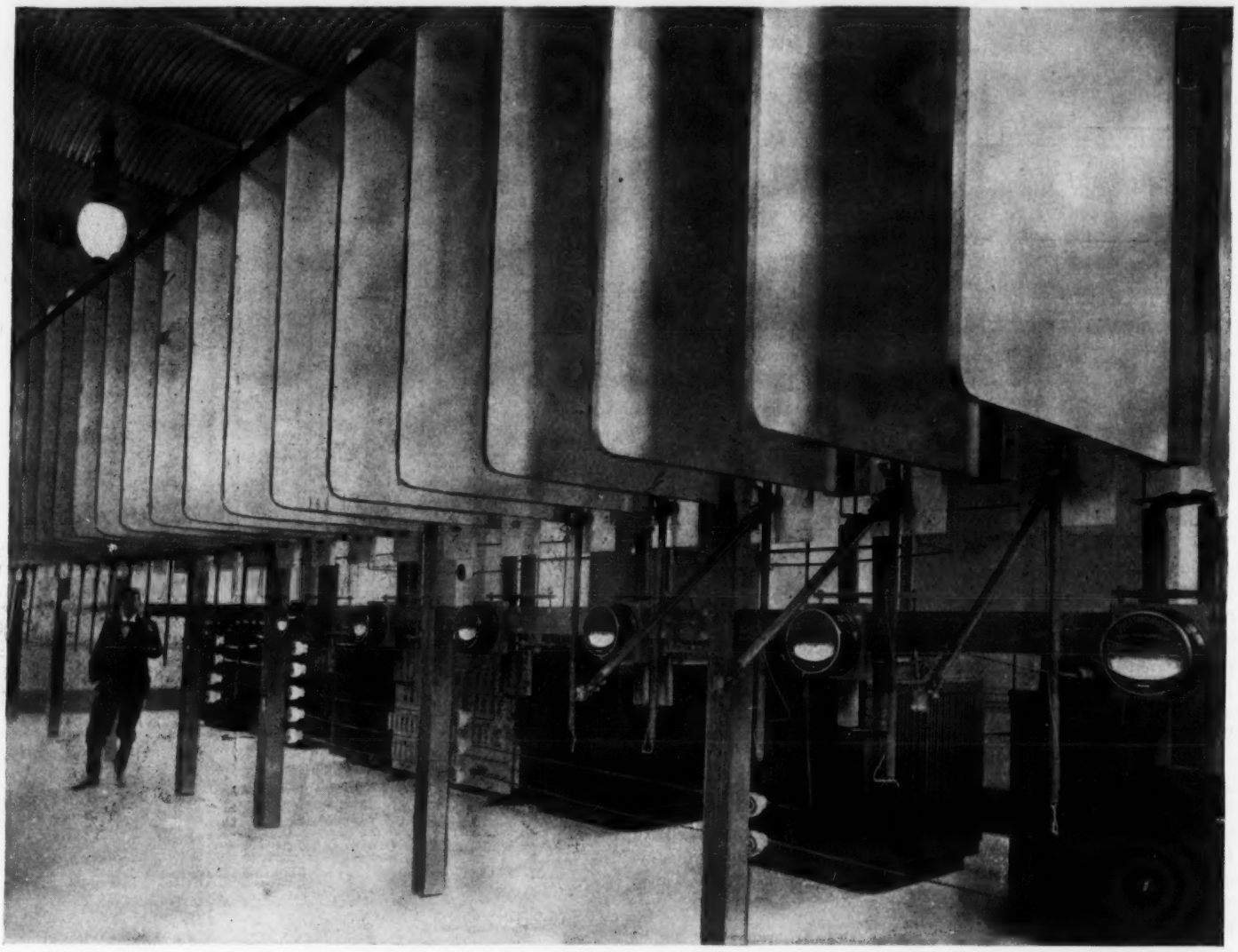


FIG. 19.—HIGH-TENSION ROOM AT FERNANDEZ LEAL.

that described for the Chiluca generating station. The synchronizing apparatus of lamps and plugs is connected across similar terminals of the 100-volt side of the 20,000-100-volt shunt transformers fed from the lines running to Madin. These shunt transformers, with the series transformers shown, are also used for the main wattmeters which indicate the amount of power received at Madin over each of the four transmission lines. This high-tension board is shown in Fig. 12, last issue.

The indicating wattmeters in the lines running to the City of Mexico have their current coils connected to the same series transformers as the ammeter, and their voltage coils are connected to the middle of six-point voltmeter receptacles, so that a voltage in phase with the current (if the power factor were 100 per cent) or one at right angles to it, can be impressed on the wattmeter. In the former case it will indicate that component of the apparent energy, *Wa*, which is in phase with the voltage, or, in other words, the true energy, *Wt*. In the latter case it will indicate that wattless component of the apparent energy which is at right angles to the voltage. Calling this, for the sake of brevity, the wattless energy, *Ww*, it can readily be shown that the relative magnitude and phase relationship of *Wa*, *Wt* and *Ww* is that indicated by the triangle in Fig. 26. As the apparent energy *Wa* is in phase with the current, and the true energy *Wt* is in phase with the voltage, the phase angle between the two is the angle of phase displacement between current and voltage.

From the triangle it is seen at once that $\tan \phi = Ww/Wt$. In other words, by comparing the reading of the wattmeter with the voltmeter plug in the two different positions, the angle of phase displacement can be readily figured out, and the angle is one of lag or lead, according as the ratio of *Ww* to *Wt* is positive or negative.

As in all of these connections two single-phase wattmeters are used on a three-phase circuit, it may be well to give a short description of their operation. For description, as well as that of the operation of the reverse current-circuit breaker given later, the writer is indebted to Mr. Conrad, of the Westinghouse Electric & Manufacturing Company.

Fig. 27 shows the connection of the two single-phase wattmeters on the three-phase circuits of this plant, as well as the phase relation of the different currents and voltages in the circuit. By this arrangement it is possible to connect two single-phase indicating or integrating wattmeters in a three-phase circuit so that with a balanced load, each wattmeter will indicate one-half of the total energy supplied, irrespective of the power factor of the circuit; and in all conditions of an unbalanced load, the sum of the readings of the meters will represent the total energy of the three-phase circuit in which they are connected.

Referring to Fig. 27, *A*, *B* and *C* are the three mires of the circuit, *D* and *E* are two wattmeters of the usual construction, giving readings proportional to the product of the current, the voltage and the cosine of the angle of phase difference between them. The shunt windings of these meters are intended for use on a 100-volt circuit, and are connected to the low-tension side of the 20,000-100-50-volt shunt transformers. The series coils of these meters are wound for a full-load current of 5 amperes. *A'* and *B'* are series transformers with 2½-ampere secondaries, and *C'* is a series transformer with a 5-ampere secondary, 2½ and 5 amperes being the secondary current with full-load current in the primary.

Secondary coils of the transformers *A'* and *B'* are connected in parallel and supply current to the series coil of the meter *D*. The transformer *C'* is connected to the series coil of meter *E*. Thus the current in the series coil of meter *D* will be proportional to the vectorial sum of the currents in the wires *A* and *B*, while that in meter *E* will be proportional to the current in the wire *C*. The shunt circuit of meter *D* is connected to the secondary side of a 20,000-100-volt shunt transformer, whose primary connections go to the lines *A* and *B*, having the series transformers which are connected to this meter. The shunt circuit of meter *E* is connected on one side to the secondary of a 20,000-100-volt shunt transformer whose primary is connected across the line *B* and *C*, and the other end of the shunt circuit of meter *E* goes to the middle point—the 50-volt loop—of the transformer connected across *A* and *B*.

Referring to that part of Fig. 27 which shows the diagram of phase relation of the current and voltages in the three-phase circuit, the line *OA* represents the current in the wire *A*, the line *OB* the current in the wire *B* and the line *OC* the current in wire *C*. The meter *D* receives its series current from the two transformers *A'* and *B'*. This current is, therefore, equal to the resultant of the lines *AO* and *OB*, and is proportional to, and in phase with, *AB*. The voltage for the shunt of meter *D* being taken from the secondary of a transformer whose primary is across *AB*, is, therefore, in phase with the current *AB*.

The series current for the meter *E* being proportional to that in the wire *C*, is equal to and in phase with the line *OC*. The shunt connections of this meter are taken from that secondary terminal of the shunt transformer connected from *C* to *B*, corresponding to primary terminal *C*, and the other end being connected to the middle point of a shunt transformer whose primary is across *AB*. In this way the shunt current of meter *E* will be proportional to a line drawn from *C* to the middle point *F* of line *AB*, and (assuming in this case a non-inductive load) this voltage line *CF* will be in phase with the current *OC*.

The scales of the meters are marked to indicate the capacity corresponding to the ratios of the transformers through which the meters

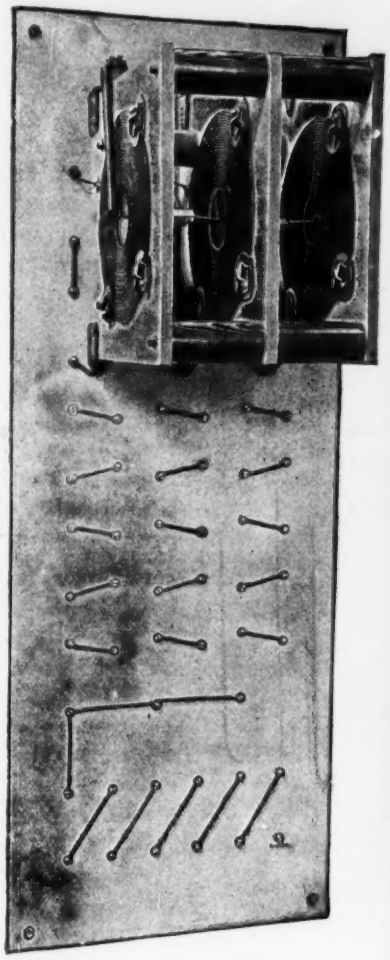


FIG. 20.—FRONT 30,000-VOLT LIGHTNING ARRESTER.

FIG. 21.—REAR 30,000-VOLT LIGHTNING ARRESTER.

are connected to the circuit. Thus if we assume a 20,000-volt circuit and series transformers having a ratio of 100 5-amperes, the meter would indicate 2000 kw, this being the product of that current and voltage when a current of 5 amperes is passed through its series coil with a pressure of 100 volts on its shunt coil.

This applies particularly to meter *E*, as meter *D* is fed from two transformers, each with 2½-ampere secondaries; but the two being in multiple produce the same result practically as 5 amperes or actually $5 \times cos\ .30$ degs. equals $5 \times .866$ equals 4.33 amperes. As will be explained later, this is exactly the current wanted in this meter. If any load on the circuit is assumed it will be found that the meters will indicate this load directly. Thus at the full load of 100 amperes per wire at 20,000 volts between wires, the energy in the three-phase circuit will be current $\times$ voltage $\times \sqrt{3}$, or $100 \times 20{,}000 \times 1.732 = 3464$ kw.

Referring again to the diagram of phase relations in Fig. 27, 100 amperes in each line will give 2½ amperes in the secondaries of trans-

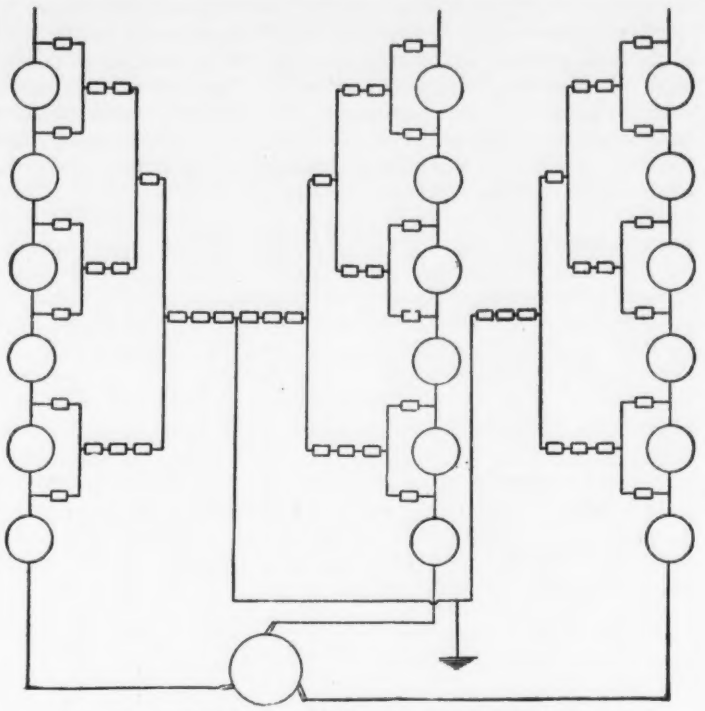


FIG. 22.—CONNECTIONS 15,000-VOLT LIGHTNING ARRESTER.

FIG. 25.—GLASS TRIPLE PETTICOAT INSULATOR.

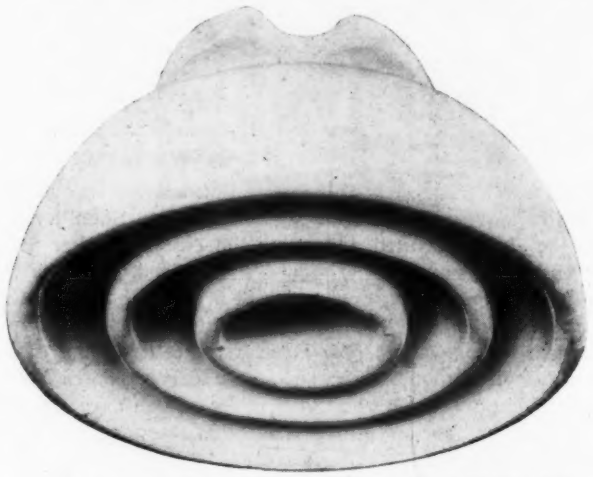


FIG. 23.—PORCELAIN TRIPLE PETTICOAT INSULATOR.

FIG. 24.—LINES AT MADIN.

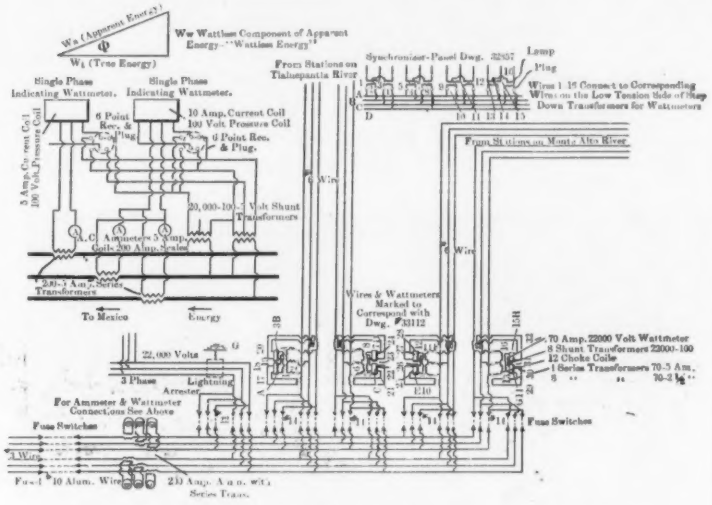


FIG. 26.—DIAGRAM OF CONNECTIONS MADIN JUNCTION.

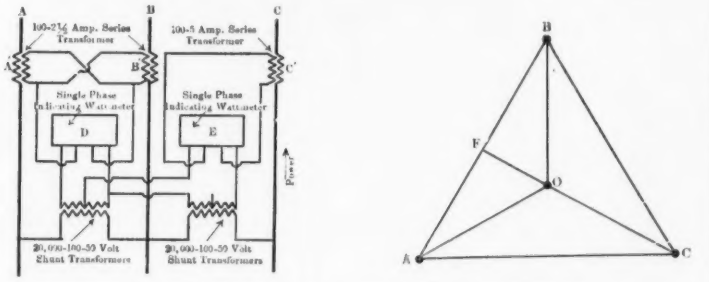


FIG. 27.—DIAGRAM OF WATTMETER CONNECTIONS.

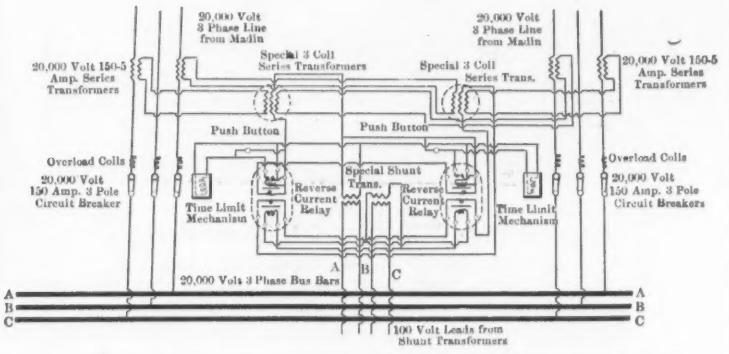

20,000 Volt 3 Phase Line from Madin
20,000 Volt 3 Phase Line from Madin
20,000 Volt 150-5 Amp. Series Transformers
Special 3 Coil Series Transformers
Special 3 Coil Series Trans.
20,000 Volt 150-5 Amp. Series Transformers
Push Button
Push Button
Overload Coils
20,000 Volt 150 Amp. 3 Pole Circuit Breaker
Time Limit Mechanism
Reverse Current Relay
Special Shunt Trans.
Reverse Current Relay
Time Limit Mechanism
Overload Coils
20,000 Volt 150 Amp. 3 Pole Circuit Breakers
20,000 Volts 3 Phase Bus Bars
100 Volt Leads from Shunt Transformers

FIG. 28.—DIAGRAM OF CONNECTIONS—REVERSE CURRENT BREAKERS.

MEXICAN TRANSMISSION SYSTEM.

formers A' and B' and 5 amperes in C'. The current in the series coil of meter D will be equal to 2½ amperes in the direction of AO and 2½ amperes in the direction of OB, which is equal to 4.33 amperes in the direction of AB. The shunt of this meter being connected to a transformer across AB will have a voltage of 100 on it, and multiplying the current by the ratio of the series transformers $\frac{100}{2\frac{1}{2}+2\frac{1}{2}} = 20$ by the voltage, and by the ratio of the shunt transformer (20,000/100 = 200), the wattmeter reading of $D = 4.33 \times 20 \times 100 \times 220 = 1732$ kw, or half of the energy.

The meter E, receiving its series current from the transformer C', will have 5 amperes in the direction OC in its series coil. As this shunt connection is equivalent to the line CF, as previously explained, this is equal to the voltage CB or CA multiplied by the cosine of the angle between CF and CB or CA. When CB equals 100 volts CA will equal $100 \times cos\ 30$ degs., or 86.6 volts. To get the wattmeter reading, we multiply the current by the series transformer ratio, 100/5 or 20 × voltage × ratio of shunt transformer (20,000/100 = 200), and we have the wattmeter reading of $E = 5 \times 20 \times 86.6 \times 200 = 1732$ kw, or half of the total energy. For any other power factor than unity the effect on each wattmeter would be to multiply its reading by the cosine of the angle of phase displacement, and it will be found that each meter still reads one-half of the total energy of the circuit.

Another point of interest in connection with the switchboard equipment of the Compania Explotadora transmission system is the pair of three-pole 20,000-volt, 150-ampere circuit breakers with time limit and reverse current attachments which are installed at the terminals of the two 20,000-volt, three-phase lines where they enter the La Veronica receiving station.

Fig. 29 is reproduced from a photograph of these circuit breakers. As shown on this photograph, each three-pole breaker consists of

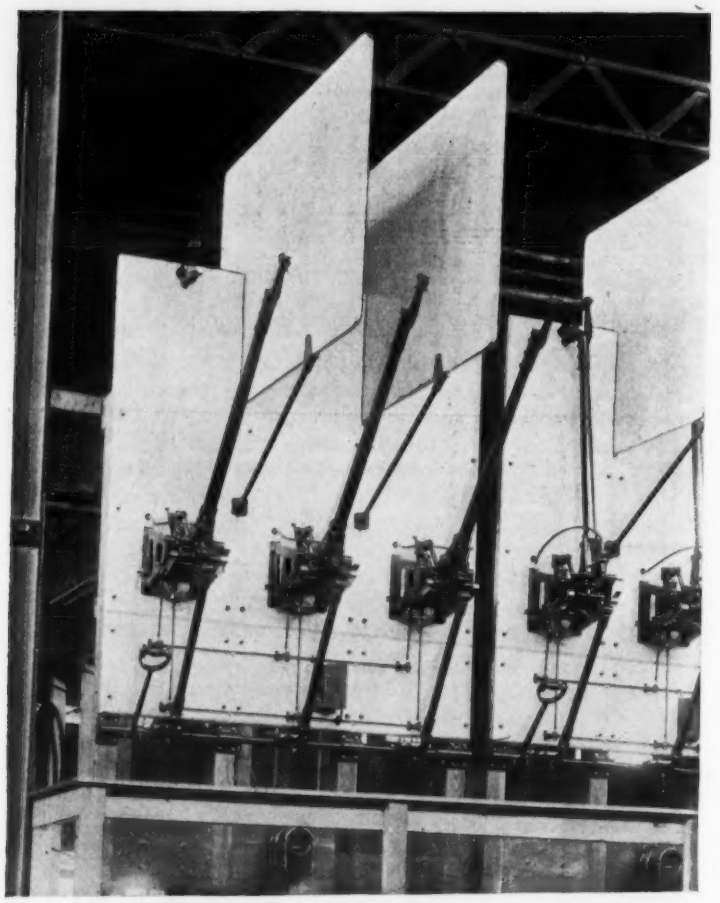


FIG. 29.—3-POLE, 20,000-VOLT CIRCUIT BREAKER.

three single-pole breakers, each mounted on a marble slab with one handle for closing all three breakers at the same time. No mechanical device is supplied for tripping these breakers together as they may be operated from a push button or the relays in multiple with each other, and either of which can trip the breaker. Below the main marble panels of the breaker are smaller panels for mounting the time limit device with its system of shafts and levers. Below this is placed the polyphase relay and the push button, the series and shunt transformers being mounted on the framework on the back of the circuit breaker. Between each pole of the breaker is a large marble barrier to prevent the arc from passing from one pole to another. Fig. 29 shows the diagram of connections for these reverse current circuit breakers. The relay consists of a polyphase wattmeter connected in the circuits in the usual manner. In place of the usual counting train, a contact operates the tripping coil on the circuit breaker. When the flow of energy is in the normal direction, the contact in the relay is held open, but should the direction of flow be reversed, the movable part in the relay will turn and close the contact, completing through the tripping coil a local circuit that operates the breakers.

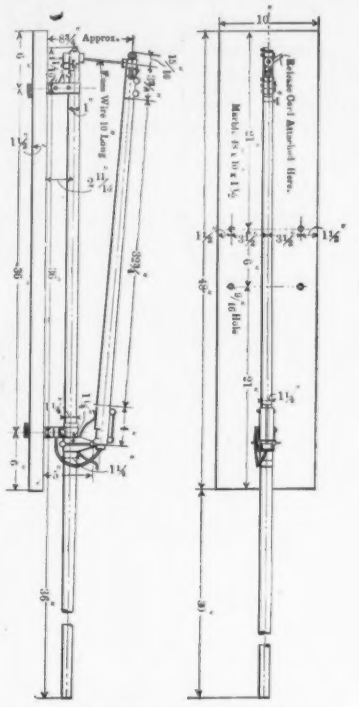


FIG. 30.—FUSED CIRCUIT-BREAKER.

The object of this device is to open a circuit whenever the direction of the flow of energy in this circuit has been reversed. This is accomplished by means of an ordinary circuit breaker, which in addition to the series tripping coil has a tripping coil wound with fine wire, and adapted to operate on a circuit of about 100 volts. This circuit is closed by a relay. On circuit breakers with time limit attachment, the magnet of the time limit is connected in place of the tripping coil.

The circuit breakers used in this installation are fed by two lines in parallel and required some additional apparatus. Should one of these lines be short circuited and cause the circuit breaker at the generator end to open, this line would still be fed from the sub-station end by the remaining line, which is in parallel with it. The result of this would be that the energy, instead of flowing over the line to the sub-station, would flow in an opposite direction, that is, from the sub-station to the line; but if the current taken by this short-circuited line was very great, it would cause an excessive drop in the other line, and so lower the voltage that the relay and circuit breaker tripping coil would not operate.

To keep the voltage up a special transformer is connected between the relay shunt and the line. This transformer gives, with normal line voltage, about 100 volts on its secondary. If the line voltage should drop to, say, about one-third the normal, the effective secondary voltage would not drop more than about 20 per cent. The primary of this transformer is wound for 100 volts, and connected to the secondary of a standard transformer with a 100-volt secondary.

A series transformer is used which has two primary coils and one secondary coil. Each of the primary coils is connected in series with similar phases of each line through secondaries of standard series transformers to obtain better insulation. This three-wire transformer is so arranged that when the currents in the two lines are in phase there is no current in the secondary; but when they are in opposition, it gives the full secondary current, the amount of which depends upon the ratio for which the transformer is wound. By means of this device no current is sent through the relay until one of the lines has been reversed. It is thus possible to make the transformers give a larger secondary current than the relays would stand continuously, thus operating them more positively. The shunts of the relays are connected across the circuit, through the medium of the special shunt transformer, which gives an approximately constant secondary voltage with variable primary voltage. This transformer performs, also, the function of keeping the current and voltage on the relay in phase.

On a long line the inductive drop forms a large part of the total drop, so that with a short circuit we should have a lagging current; and as the operation of the relay depends only on the true watts, the lagging current ordinarily tends to lessen the positive action of the relay. The special shunt transformer, however, gives a secondary

voltage leading in phase with respect to the primary voltage. The relay device is so adjusted that it gives its maximum effect with the shunt voltage leading. If an excessive current cause a drop in the line, the secondary voltage will shift and keep in the same phase relation to the series current in the relay. Thus the pull in the relay continues a maximum, even with a large lagging current in the line. The shunt transformer is designed to shift the phase of the voltage in the same proportion as an excessive line current causes an inductive drop in the line.

The function of the time limit on these circuit breakers is to delay for some predetermined length of time the opening of the circuit breaker, so that a momentary overload where the series coil comes into play, or a momentary reversal where the reverse current relay acts, will not open the circuit instantaneously. This time limit can be set to delay the opening of the breaker from one to ten seconds.

From the 20,000-volt, three-phase bus-bars in the La Veronica receiving station, the current passes through 20,000-volt fused circuit breakers to the lowering transformers. Fig. 30 shows an outline of one of these fused circuit breakers, consisting of two stationary contacts on a marble slab with a removable pole. In closing this breaker the upper contact on the pole is hooked over the upper stationary contact on the marble, and with that point as a fulcrum the pole is swung in until its lower jaw makes contact with the bottom block on the marble.

This removable pole comprises a stationary arm and a movable one hinged together. A strong spring tends to separate the arms. This tendency is resisted by the mechanical strength of a piece of aluminum fuse wire which passes through carbon blocks at the ends of the arms. An overload causes this fuse wire to melt and the movable arm flies out, opening the circuit. To renew the fuse the fixed arm is lifted from its contacts and the fuse replaced in safety. To trip this breaker when the fuse has not blown, it is only necessary to pull a cord operating a latch and releasing the fuse wire.

The method of mounting these fused circuit breakers is shown in Fig. 19, on page 503. In the high-tension room at Fernandez Leal, the most striking point of interest is the large wooden shields covered with asbestos, these being used to separate the different breakers.

Sub-Marine Cable Laying During a Canadian Winter.

BY G. U. G. HOLMAN.

ON Dec. 6, 1901, was laid in the St. Lawrence River between the cities of Quebec and Levis, Canada, a cable, to be used for conveying electric power from Levis to Quebec. The successful laying of this cable ensured the successful carrying out of the terms of the contract for 750 kw to be supplied to the Quebec Railway, Light & Power Company, of Quebec City, by the Canadian Electric Light Company, of Levis, P. Q. It was considered to be a difficult, if not impossible, piece of work to lay an electric power cable between the shores of the St. Lawrence River at the above point, the cable measuring approximately 3 inches in diameter and weighing 7 lbs. to the foot, with the obstacles offered by thickly packed, floating ice, varying in thickness from 6 to 24 inches.

The cable consisted of four stranded conductors, each equivalent to one No. 2-0 B. & S. solid wire, and four No. 16 solid wires, used for pressure wires. About each of the stranded conductors was a rubber wall 5-32 of an inch in thickness served with one layer of tape and then covered with a serving of tarred jute. There was a tarred jute center and the conductors with the above serving were concentrically wound about this center and held in place by a double serving of tape. The four pressure wires, each having a ⅛-inch rubber compound wall, were laid in between and on the outer periphery of the larger conductors before this wrapping. The whole was then heavily served with tape and covered with a tarred jute cover and then armored with a spiral winding of No. 6 galvanized steel wire. The armor was covered with a serving of tarred jute in order to assist in protecting the cable in its journey from the works of the Safety Insulated Wire & Cable Company, of New York, to Levis. The cable is now delivering 750-kw alternating current at 2200 volts, and was tested at the factory as follows:

Each conductor before being made up into a cable was tested from ground at 20,000 volts alternating, for a period of three minutes, and after being made up into the cable was tested from ground and from each other conductor at 12,000 volts for a period of one minute. The pressure wires were tested from ground and from each large conductor at 12,000 volts for one minute. No fault appeared.

The accompanying illustrations show the ice conditions amid which the cable was successfully laid, after waiting a period of seven days with the cable on the ground, hoping each day for a lesser quantity of ice with a consequent greatly decreased danger of having the cable-laying apparatus interfered with, either by the ice puncturing the sides of the lighter which held the laying reel, or by the greater ease with which it would have been possible to have made a direct alignment from shore to shore. On the arrival of the cable, which was shipped on a flat car with stakes and boards on its side in order to prevent the cable, coiled in a figure 8, from becoming injured in transit, it was immediately, and in the midst of a snowstorm, coiled upon a huge reel, which in turn was mounted on a lighter (see Fig. 2). The reel flanges were 12 ft. in diameter, and its length 10 ft., the drum being approximately 5 ft. in diameter. We were enabled to coil nearly all the cable upon this reel, a few hundred feet being left on the lighter's deck coiled in a figure 8. We were then ready for the cable laying, and for that purpose had held a tugboat in commission since navigation had been closed and all other boats put up for the winter, from the 1st of December. The reel in question was the joint property of, and was kindly loaned by, the Great Northwestern Telegraph Company, Limited, and the Bell Telephone Company, Limited, of Canada.

FIG. I.—PREPARING TO LAY CABLE.

On the seventh day of readiness to lay this cable we finally decided to do so, and started at flood tide from the Levis shore, against which the ice was most thickly packed, with the idea that if we got into trouble we would get it quickest at that point, and with the least cable paid out. At this shore the channel is also deepest, being 167 ft. at mean tide, the tide at Quebec being about 18 ft. The distance from wharf to wharf at the two shores is 3400 ft. The amount of cable provided was 4400 ft., of which we had remaining after the cable was laid and connected to the terminal boxes, 350 ft. This will be used in future possible repairs.

When finally ready for the cable laying we secured one of the ferryboats of the Quebec & Levis Ferry Company, Limited, which winter boats are good ice-breaking boats. This ferryboat preceded

the tug, to the stern of which was attached the cable lighter. The cable, however, was first attached to the Levis shore by tying a ¾-inch chain to the cable at two places and reeving the chain through the timbers of the wharf, an admirable place for the landing being secured by the Canadian Electric Light Company in a dock about 30 ft. wide flanked on either side by crib walls of excellent construction. This dock ran in for 40 ft., forming an excellent protection from floating and anchor ice. A spot for the Quebec landing was obtained at the corner made by a crib wharf and a projecting crib pier running out into the river some 40 ft. One of the vertical planks was removed from this corner, and the cable at landing, after being cut, was reeved through the timbers below low-water mark on the subsequent day, the cable being chain anchored as on the other shore. The time of the cable laying was 13 minutes.

A cable box on a terminal pole on both shores contains the single-pole static discharges to which each cable conductor is attached, the cable first running through a terminal bell end, filled with compound to protect the cable from static discharge. At the Quebec end the four conductors and four pressure wires are run out through porcelain tubes and have been connected to a trunk line running to the sub-station of the Quebec Railway, Light & Power Company, 7500 ft. away. A terminal box on the Levis shore is a duplicate of that on the Quebec side, the terminals being connected with the trunk line fed by the Levis sub-station of the Canadian Electric Light Company. This trunk line is 3300 ft. long. At the sub-station three sets of special step-down regulating transformers have been installed, which were built by the Wagner Electric Manufacturing Company,

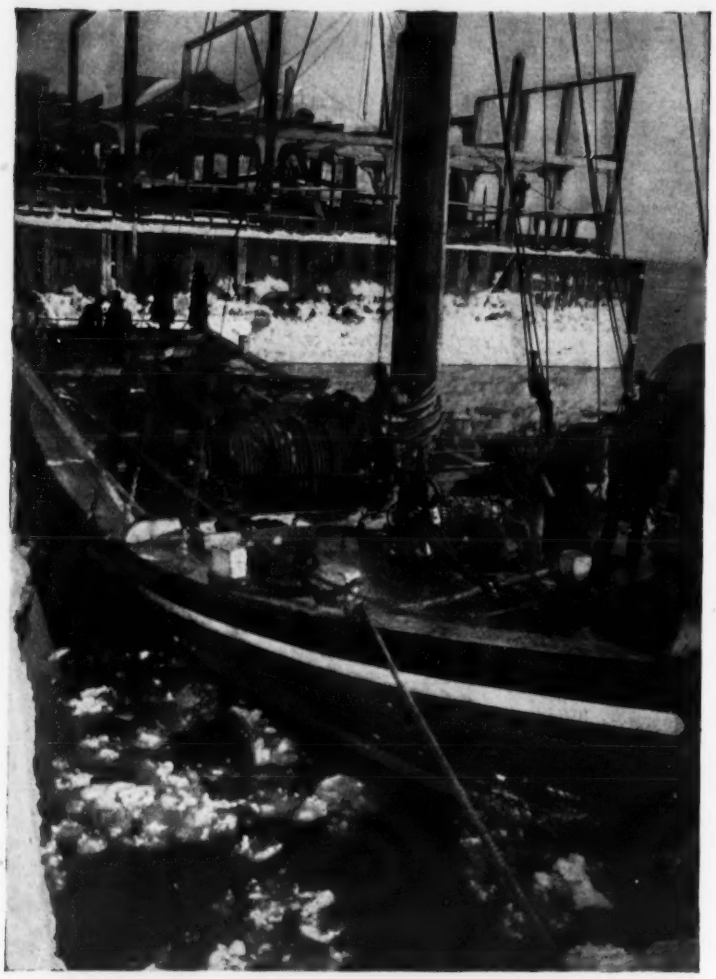


FIG. 2.—REELED CABLE ON LIGHTER.

of St. Louis, Mo. These transformers regulate on the low-tension side from 2700 volts to 2240 volts, thereby providing for the varying drop on the trunk lines by the cable in supplying the minimum and maximum power to the switchboard of the Quebec Company.

Power was first supplied to Quebec through this cable in any quantity, on the 12th of February, the initial amount being 225 kw, and the installation is a success. Credit is due to Mr. Wm. Rodier, of the Safety Insulated Wire & Cable Company, for the cable laying amid the difficulties of a Canadian winter.

SUB-STATION.

The water power development and the two sub-stations of the Canadian Electric Light Company, one at Levis and one at St. Romuald, both on the south shore of the St. Lawrence River, have previously been described in these columns, but the fulfillment of the contract for 1000 hp to be delivered in Quebec City by the Canadian Electric

FIG. 3.—LAYING THE CABLE.

Light Company called for additional and special apparatus. It was, therefore, decided to build a new sub-station building in Levis within a few hundred feet of the old one, in order that additional apparatus could be installed, and a little later the step-down transformers of the old station, be transferred to it. This new building, shown in plan and elevation in Fig. 4, is a one-story brick structure of an interior dimension of 36 ft. by 20 ft. and 18 ft. height of side wall, with a peaked roof. Fig. 5 shows the switchboard.

Additional transformers for the Quebec load consist of three sets of two step-down transformers each, making six transformers in all, the capacity of each being 200 kw, or 400 kw per set. Each transformer is built to transform 10,000 volts, three-phase at 66 2-3 cycles to a potential of 1980 volts, two-phase, but with the additional provision of a dial switch in each case, to which leads of the secondary coils were brought in order that the secondary potential may be regulated from 2200 to 2700 volts. It will be noticed that the movement of the finger contact of this dial switch is controlled by hand wheels on the transformer panels. There are two sets of bus-bars for controlling the two-phase circuit coming from each set of transformers. One bus has been termed the local bus, the other the Quebec bus. The regulating transformers may be connected to the local bus when their ratio is 10,000 volts to 1980 for use on the local lighting and power circuits. Two other transformers in the sub-station were in the old building, and are Westinghouse transformers having a ratio of 10,000 volts, three-phase to 1980 volts two-phase, with no regulating coils. By providing 1200 kw capacity in the regulating transformers there is ample provision made for supplying the 750 kw to Quebec with a complete spare unit. This spare unit will also act as a reserve unit for the local load, as above indicated. The regulating transformers and the new switchboard are the product of the Wagner Company, of St. Louis.

The three-phase lines from the water power station 8½ miles distant consist of two separate, medium hard-drawn, bare No. 4 copper wires. As shown in Fig. 5, each line is controlled just within the station wall by a G. E. 15,000-volt, 100-ampere, triple-pole, single-throw oil circuit-breaking switch, hand controlled from the switchboard panels. Through each switch a line is connected to one section of a bus consisting of three sections, the third section being provided for a future third line from the generating station. Each set of step-down transformers is connected, with the intervention, however, of a similar circuit-breaking switch, to certain sections of the 10,000-volt bus. In the event, therefore, of a breakdown, or trouble, from one of the operating transformer units, it can be cut out of service with a consequent greater safeguard to the apparatus, as each switch is capable of breaking the full ultimate load of the generating station, which will be 7500 kw.

The sub-station is provided with a traveling crane, which paid for

itself in the installation of the apparatus, and will make future repairs to possible breakdowns in the transformer coils, far quicker than otherwise. Provision is also made that the building can be extended with the growth of the business.

The six regulating transformers are of the air-blast type, the air being supplied by a Sturtevant blower driven by a single-phase Wagnately was on the sub-station site. The sub-station building is provided with double windows and an outer or storm door, which is necessary to keep out the cold of a Quebec winter.

From the sub-station building on the secondary side are the conducting feeders, the trunk line running to the Quebec cable being fed directly from a Quebec panel. It will be noticed that each feeder

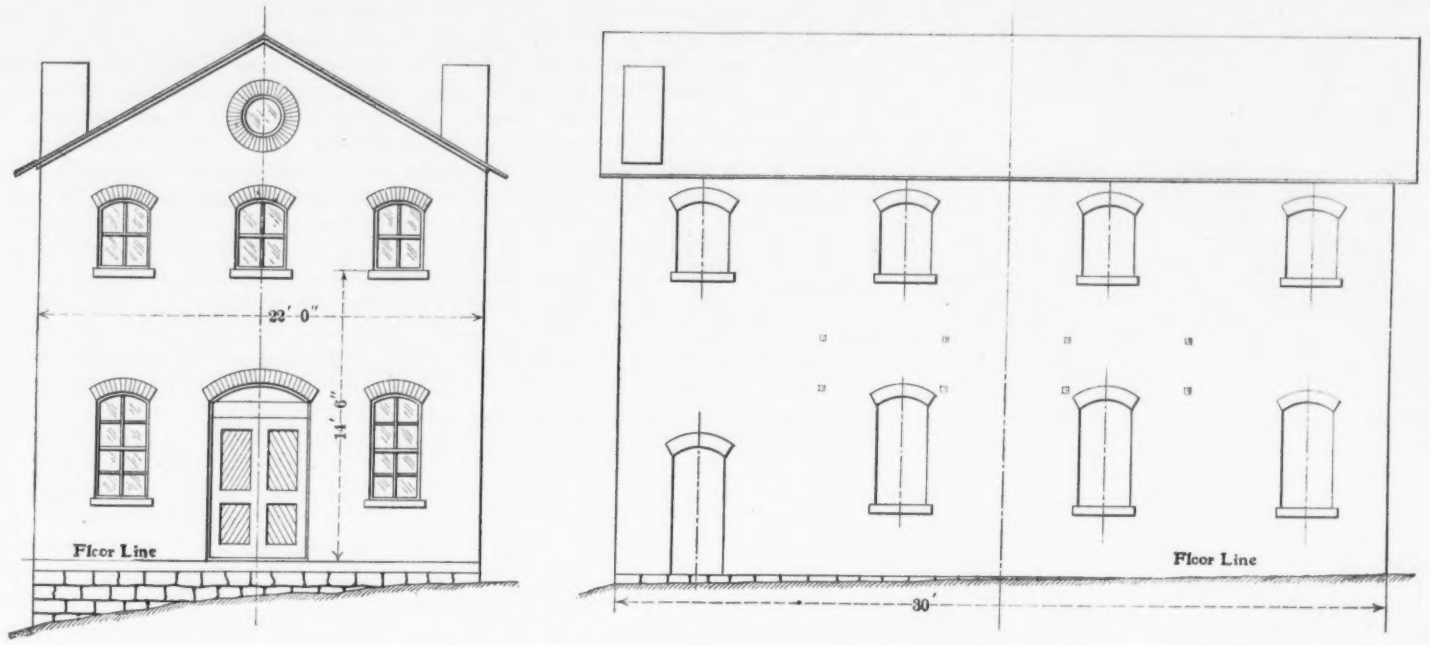


FIG. 4.—LEVIS SUBSTATION, CANADIAN ELECTRIC LIGHT COMPANY.

ner motor, two of these motors being provided; in case of a breakdown to one the other could be called upon. There were also installed one 20-kw and one 3-kw transformers, 2000 volts to 220 volts, so arranged with a double-throw switch that either motor may be operated by either transformer. This provides against a possible breakdown in the motor transformer. The disparity in the size of

panel—except those belonging to the incandescent street light system—has mounted on it oil, circuit-breaking, automatic switches, which were manufactured by the General Incandescent Arc Light Company. Inspection of the switchboard design will show that the pressure wires from Quebec run back to voltmeters on the Quebec panel, making it easy for the sub-station attendant to provide the necessary volt-

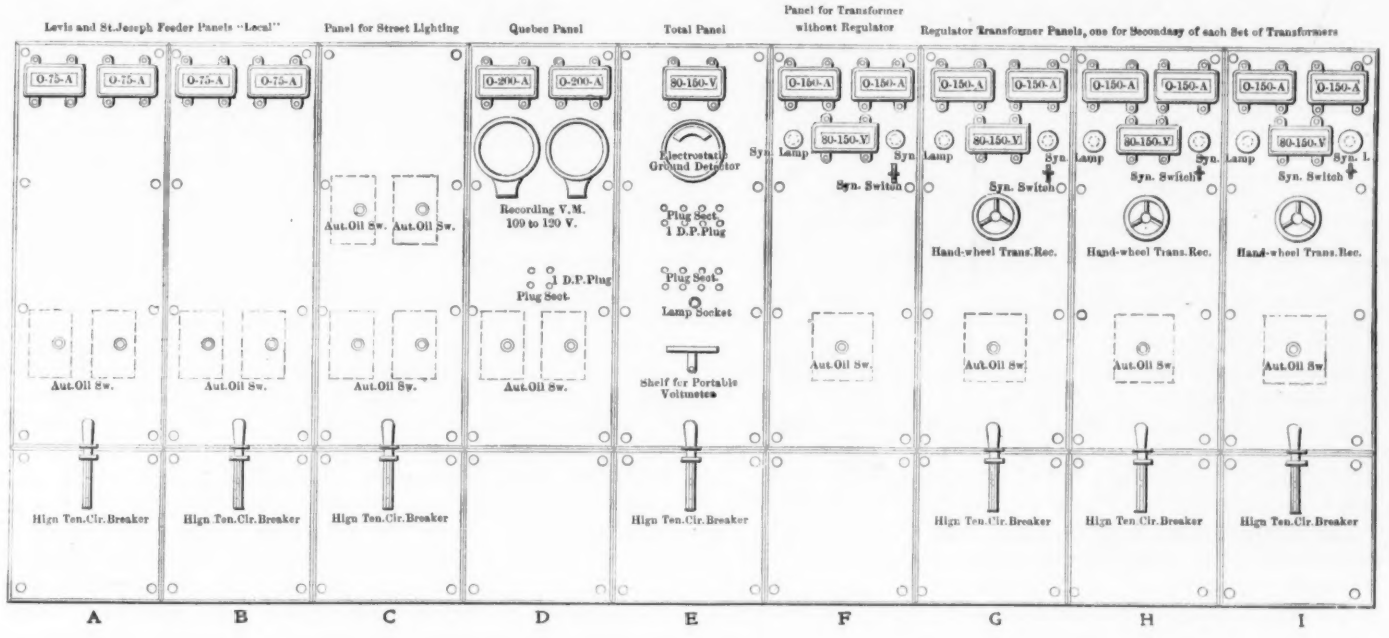


FIG. 5.—ELEVATION OF SWITCHBOARD, CANADIAN ELECTRIC LIGHT COMPANY, LEVIS.

the two motor transformers is due to the fact that the larger transformer is used in winter for supplying the energy to four Detroit 3-kw heaters of the bracket type placed against the wall of the building.

The foundations of the transformer and the ducts, both air and wall, are of concrete and laid on a solid rock foundation, which fortuage required at the Quebec distributing board. At this Quebec end there is to be provided a recording maximum power meter, for the mutual satisfaction of each company. Credit for the prompt installation of this machinery in order to fulfill its contract, is due to Mr. A. R. Henry, general superintendent, and Mr. Cyril R. Reade, construction superintendent of the Canadian Electric Light Company.

Problems of the St. Louis Exposition.

By Luther Stieringer.

TO those who do not study the subject, and look upon an exposition simply as another means of amusement, it doubtless seems that most expositions are alike, varying chiefly in size and in the addition or subtraction of one or two sensational features. To those who have been compelled to give the subject their best thought, every new exposition presents some new problem of its own, especially of late years. In the earlier period of exhibition work, one show was practically a duplicate of that which had preceded it, but nowadays the desire for that which is unique or sensational drives the organizers and architects of each successive "world's fair," or whatever else it may be called, to seek for some effect that has never been previously attempted. This in itself is a great danger that confronts all exposition managements, which also have to contend with the erroneous idea so widely entertained by the unthinking portion of the community, that mere size is merit in itself. As a matter of fact, expositions would gain greatly in economy and effectiveness if their managers would only subscribe to a self-denying ordinance to the effect that the latest exposition should not be larger than its predecessors, but smaller.

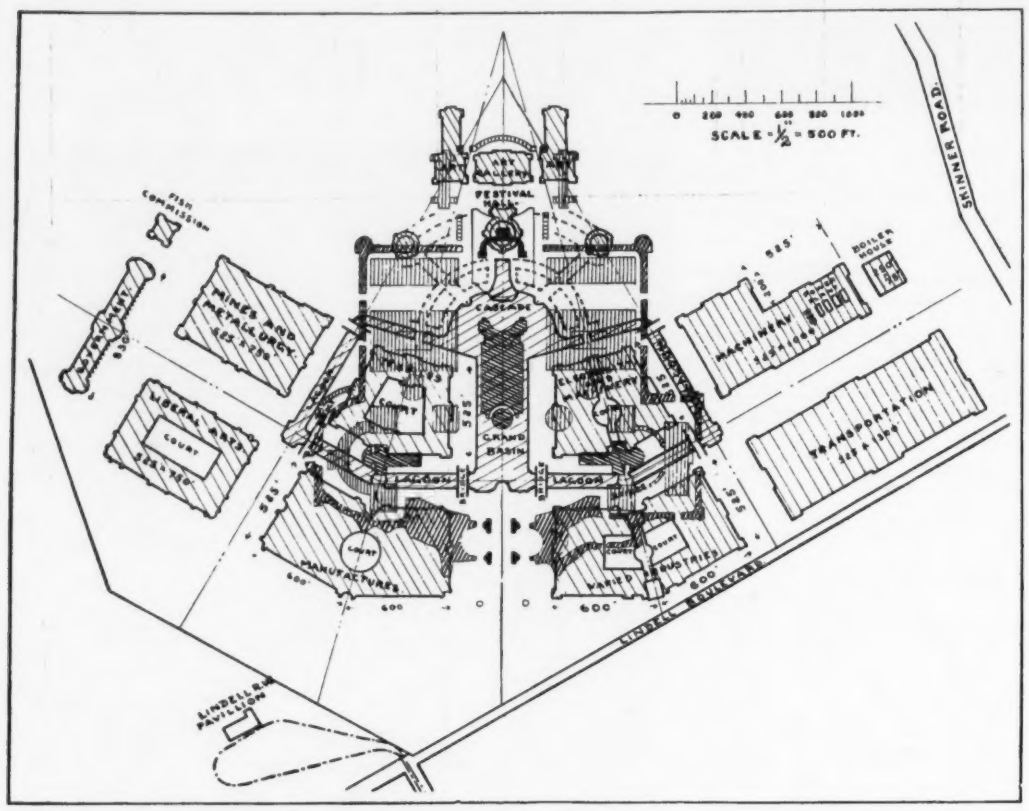


Diagram Showing Relative Areas of Pan-American and St. Louis Expositions.

That we have not reached this point in America is certainly shown by the data now available in regard to the St. Louis Exposition proposed for 1903, but more likely to be held in 1904. The question has of late been frequently asked of the writer, how does the Louisiana Purchase Exposition compare in extent with Chicago in 1893 and the more recent Pan-American expositions of Omaha and Buffalo? The best answer to this question is found in the composite plan submitted herewith, based upon the data now available, showing the relationship in area which the Buffalo Exposition of last year bears to the St. Louis Exposition soon to be held. The writer in preparing for his work as consulting electrical engineer at these great shows has always found it very helpful to institute such comparisons for his own instruction, and he thinks that the diagram now presented will be found interesting by a great many people. It will be clearly understood, however, that this map is confined strictly to main exhibit area, and that proportionate figures would apply to auxiliary and State buildings, midway shows and other extraneous features.

At the St. Louis Exposition there will be over 4,000,000 sq. ft. in the main buildings alone, while another large building, 2000 by 225 ft.—the largest of them all—is projected for agriculture paralleling and flanking Machinery Hall. This represents fully as much space as was in similar buildings at the Chicago World's Fair in 1893. None of the other expositions in this country, however, since Chicago, have exceeded 600,000 sq. ft. in main exhibit building space. This simple fact in itself will illustrate the magnitude of the plans adopted at St. Louis. The contrast in another direction is even more marked. This will be observed upon studying the principal areas within and surrounding the main buildings, such as the terrace lagoons and the canal court. The bearing of all this upon questions connected with lighting, structural illumination effects, power transmission and special spectacular displays is apparent to any one who has had anything to do with exposition work.

The St. Louis Exposition in the arrangement of the architecture of the main buildings, is one of the few that may properly be designated as productive of a court setting. This will be evident upon a glance at the main court or center axis, which presents an extreme vista of upwards of 3000 ft. in length. The Court of Honor at Chicago, magnificent and ever memorable spectacle as it was, had but 1800 ft. from the Administration Building to the Quadriga. In addition to this vast area, however, at St. Louis there are the lagoon courts, as shown upon the ground plan herewith. All of this lends itself to an admirable stage ensemble, especially for night illumination, although from his own experience the writer would be inclined to anticipate the criticism that the court needs to be closed in at the Lindell Boulevard end in some stately and appropriate manner, just as the vista at Buffalo was by the pylons, or as the Chicago Court of Honor was by the Triumphal Arches and statuary that shut in the enclosure from Lake Michigan. This, however, is likely to be done.

The large scale upon which the classical architecture of the St. Louis main buildings is projected will, it seems to the writer, admit of a more extensive scheme of illumination than the Pan-American, which was so much admired, and in regard to which the fervent eulogies of the press and the public have come more as a surprise than as a matter of course, although it was but an amplification of the results aimed at in Omaha. The fear that St. Louis would be handicapped electrically in not having as a source of power Niagara Falls, has been exaggerated. The advantage possessed in this respect by the Pan-American was in reality more assumed than real because, after all, the current had to be transmitted some 20 odd miles from the Great Cataract, a fact which is offset in St. Louis by the well-known cheapness and availability of fuel at that great center of Southwestern transportation. It will be helpful, in this respect, to glance once more at the map and note the location of the power plant at the outer end of Machinery Hall, with the boiler plant adjoining. The inclusion of this plant within the ground obviates and avoids all problems of heavy current transmission, such as complicated the situation at Niagara. There is no good reason why St. Louis should not eclipse in electrical magnitude its predecessors, that have won so much glory and praise in this respect, and it is only to be inferred from the contracts which have already been awarded, that a spectacle of the first order will be provided. It all depends on how the problems are met and the conditions are dealt with, and here the best talent that the country affords will have its opportunity. So far as the spectacular illumination partakes of the architectural or structural character, possibly the Pan-American represents the furthest reach, but there are many other ways in which the protean arts of electricity can be employed, and it is here that the test of versatility and originality will be found.

The Economic Design and Management of Telephone Exchanges—IX.

BY ARTHUR V. ABBOTT, C. E.

THE EFFECT OF OBSTACLES.

IT often happens that the topography of the territory under consideration prevents the complete utilization of the shortest rectangular routes to all stations, and the effect of such interference in causing circuitous routes must be taken into consideration in selecting the telephonic center. An example of such a case is given in Fig. 14. By the rule given under the hypothesis that all subscribers could be brought to the office by the shortest rectangular routes, the axes would be $x\ x$ and $y\ y$, with the telephonic center at T.

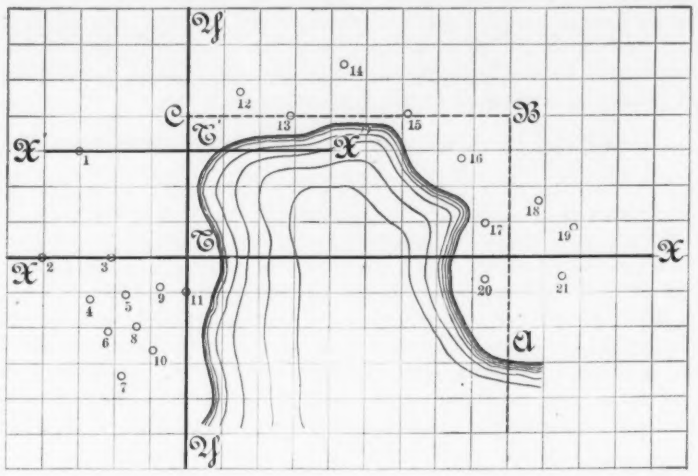


FIG. 14.—EFFECT OF OBSTACLES IN DETERMINING TELEPHONIC CENTRE.

But suppose that, owing to some unsurmountable obstacle, the stations from 12 to 21, inclusive, *must* be brought to T along the line $A\ B\ C$. Evidently, the effect of bringing stations 12 to 21, inclusive, to the telephonic center along $A\ B\ C$ is to deliver 10 lines at the point c on $y\ y$, and cause them to reach the office along $y\ y$. This is equivalent to moving them and concentrating them on the line $y\ y$ above $x\ x$. If, now, 10 stations are supposed to be at c, then the axis $x\ x$ must be shifted to $x'\ x''$ in order to fulfill the condition of equality in number of stations on each side of it. The true telephonic center is then at T' instead of T.

VI. THE EFFECT OF DIAGONAL STREETS.

In many cities, particularly the older ones, diagonal streets are of occasional occurrence that may be employed for wire routes, and

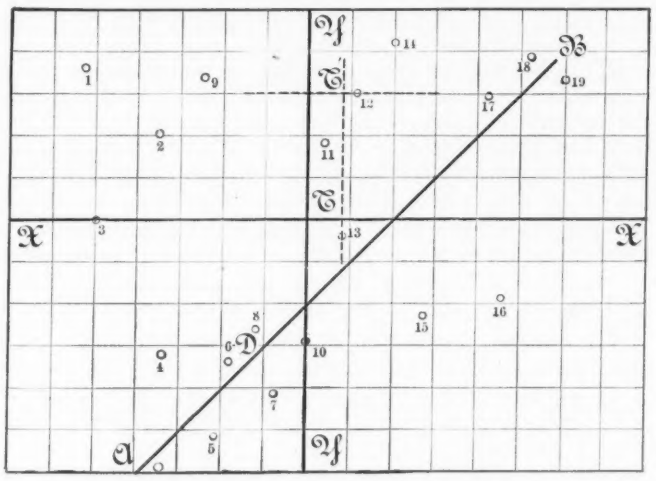


FIG. 15.—EFFECT OF DIAGONAL STREETS.

produce a saving in mileage over that required by running strictly rectangularly. While the advantageous use of such streets is infrequent, it is necessary to consider their effect on the location of the telephonic center in order that a complete solution may be found.

When a diagonal street can be employed that portion of each subscriber's line which follows the diagnoal street becomes approximately an air line, and is no longer referred to rectangular co-ordinates. Then each circuit will either be measured all rectangularly, all straight, or partly rectangularly and partly straight. This mixing of the methods of measurement so complicates the problem that no direct mathematical solution has been discovered, and it is only possible to ascertain the telephonic center by the method of trial and approximation, best accomplished by reference to a map on which the station locations are plotted. A concrete example will elucidate this method. In Figs. 15 and 16, let the line $A\ B$ represent any diagonal street intersecting the co-ordinate axes at any angle whatever extending any length. Let T be the telephonic center referred exclusively to the rectangular axes. Simple inspection shows that the stations which lie closely to $A\ B$ can reach T with the expenditure of less mileage by following the line $A\ B$ till it intersects either of the axes, and then proceeding along the axis, than by taking a purely rectangular course. But it is a question whether a new location for T at some other point would not still further economize mileage. Examining Fig. 15 it is seen that there are 19 stations, of which eight, Nos. 4, 5, 6, 7, 8, 17, 18 and 19 can shorten their wire mileage by taking the street $A\ B$, while for the remaining 11 the rectangular route would be the shortest, so there will be eight stations that can employ $A\ B$ to advantage and 11 that cannot. For these 8 stations that use $A\ B$, the location of the office on this line will give shorter wire routes than any point outside the line. If the office is not placed on $A\ B$, then these 8 stations must have their lines lengthened to reach it at some other point. But there are 11 stations that could not use $A\ B$, and for whom the best office location would be somewhere outside $A\ B$. Hence, if 8 stations have their wire mileage increased by moving off $A\ B$, and 11 their mileage have it decreased, it will not be economy to locate on $A\ B$. Turning to Fig. 16,

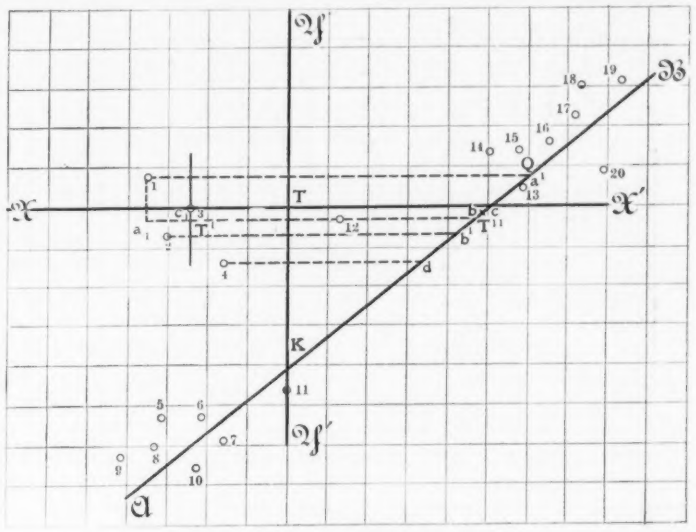


FIG. 16.—EFFECT OF DIAGONAL STREETS.

it is seen that there are 20 stations, of which 14 could use $A\ B$ as a portion of their wire route. Evidently, in Fig. 16, the conditions of Fig. 15 are reversed, that is, a greater number of stations could use the diagonal street $A\ B$ than would reach the point T rectangularly. Therefore, the effect of diagonal streets on the office location depends only on the question as to whether a greater number of stations can use the diagonals to advantage than can reach the office rectangularly.

To ascertain this condition locate the telephonic center for rectangular co-ordinates and draw the axes, then

1. If diagonal streets are found cutting only one of the quadrants, the use of such streets will not affect the office location. For (refer to Fig. 17) let $A\ B$ be the direction of any diagonal street in one quadrant making an angle a with the line $A\ C$, which may be either the axis of x, or y, or a line parallel to either, and assume the office to be at A, or anywhere to the left and above the point A. If any station, or cluster of stations, at any point N be brought to the office by rectangular co-ordinates, the location of the wire route will be from N to O, thence from O to A, and thence to the office, or by some equivalent rectangular route. If the diagonal street $A\ B$ be used as a portion of the route, the line will run from N to Z, from Z to A, and thence to the office. From A to the office the length of the route is not affected by the use of the street $A\ B$, hence it is only necessary to deal with such a part of the route as is to the right of and below A. The distance from N to A measured rectangularly is $A\ O + O\ N$.

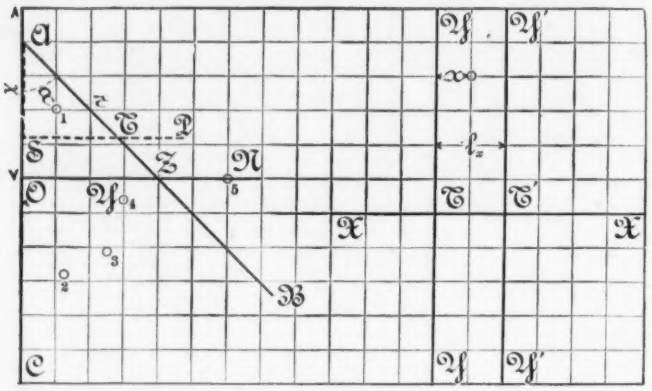
Let $X = A\ O$ and $Y = O\ N$. Then the distance $r = A\ Z$ (the

portion of the diagonal street occupied) is given by the expression $\frac{X}{\cos a}$ and the distance $z\ n$ by $y - \frac{X}{\sin a}$ and the total distance from A to N using $A\ B$ is $\frac{X}{\cos a} + y - \frac{X}{\cos a}$.

If the office is not at A, but at some other point distant rectangularly D miles from A, the total mileage for the group N from the office will be $D + \frac{X}{\cos a} + v - \frac{X}{\sin a}$.

Turning back to Eq. 3, it is evident that any term in this equation may be replaced by the preceding expression for station mileage via diagonal streets, and if the same mathematical reasoning and processes be applied to the equation so obtained, the same condition is found to hold true for U and V, hence the location of the office is not changed by the employment of diagonal streets in this case.

To determine the distance from the office of such stations as can use diagonal streets, recourse may be made to the map on which the stations are plotted, and scale measurements made from the office to A, thence from A to Z, and thence from Z to N. If desired, the following geometrical construction may be employed to locate such stations as can make use of diagonal streets in such a hypothetical situation as will make their rectangular co-ordinates in their new position equal in length to the mixed rectangular-diagonal distance of their true position. From the point A lay off $A\ S + S\ T$ equal to $A\ Z$. From the point T draw $T\ P$ parallel to the axis of y and equal to $Z\ N$, then the sum of the distances $P\ T + T\ S + S\ A$ is equal to $A\ Z + Z\ N$. Therefore, so far as length of lines is concerned, it is allowable to assume the group N as located at P, and to measure the



FIGS. 17 AND 18.—EFFECT OF MOVING TELEPHONIC CENTRE.

distance to the office rectangularly along $T\ S$ and $S\ A$, for this gives identically the same length as $N\ Z$ and $Z\ A$.

2. If diagonal streets be found passing through two quadrants, it is possible, though not probable, that the utilization of these streets will change the location of the telephonic center. The method of determining this is given under case third below.

3. If diagonal streets be found passing three quadrants or more, it is probable, though not certain, that the employment of these streets *will* change the location of the telephonic center. To determine whether the office is moved to a new position, turn back to Fig. 16. Using rectangular co-ordinates, the telephonic center is at T.

By inspection, it is seen that stations 5, 6, 7, 8, 9, 10, 13, 14, 15, 16, 17, 18, 19 and 20 can avail themselves of the line $A\ B$, while stations 1, 2, 3, 4, 11 and 12 would use rectangular co-ordinates to reach T. Consider first the stations that can use the line $A\ B$. The location of the office for these will be somewhere on the line $A\ B$, at such a point as to numerically bisect the number of stations that follow this route. As there are 14 stations that can use $A\ B$, the office will be located between the seventh and eighth station or at the point Q. Inspection shows that if Q be moved to cross station 13, then for every unit it moves toward A, the lines to eight stations will be increased and to six stations decreased. By the same reasoning, if Q moves across station 14, the same condition will prevail, therefore, so far as these stations are concerned the office must be placed at Q between stations 13 and 14. Turn now to stations 1, 2, 3, 4, 11 and 12. It is possible to locate the proper telephonic center for these stations considered by themselves, which is found to be at T'. It is now necessary to combine the points T' and Q to obtain the true minimum mileage. As there are 14 stations that can use $A\ B$ advantageously, and only six that cannot, it is probable that the best office location will be somewhere on $A\ B$. Suppose each of the stations 1, 2, 3, 4 and 12 be brought to $A\ B$ by straight lines parallel to X, as shown by the dotted lines, to the points $a\ b'\ b\ c\ a'$, while station 11 is brought along $Y\ T\ Y$ to k. It has been shown that the proper office site for the stations 5, 6, 7, 8, 9, 10, 13, 14, 15, 16, 17, 18, 19 and 20 is at Q, but by the introduction of stations 1, 2, 3, 4, 11 and 12, five additional lines will run toward Q from A, and one from B, so, now, there will be 12 lines to Q from A, and 8 from B. Hence Q must move toward A till it crosses two stations, thus numerically bisecting the total number. This will be at the point T'', between the lines from stations 3 and 12. Whenever, therefore, diagonal streets arise, the three preceding criteria may be applied to determine whether the use of such streets will cause the office to leave the telephonic center of rectangular co-ordinates. As the application of these criteria is a matter of some considerable labor, in a large group of stations, it is usually possible to decide, from a careful inspection of a properly prepared map, whether such departure will be of sensible magnitude, and of sufficeint importance to justify spending the time needed for exact location by the preceding method of trial and approximation.

VII. THE EFFECT OF MOVING THE TELEPHONIC CENTER.

It is often impossible, and sometimes inexpedient, to place the office exactly at the theoretical telephonic center, so it is necessary to consider the effect on the expense of the wire plant of a departure from the true location. The removal of the office in any direction is equivalent to shifting either, or both, of the co-ordinate axes. Let S be the total number of stations in the territory, and L the average rectangular distance to all stations, so that $S\ L$ is the total wire mileage to reach all stations from the telephonic center. Now, suppose the axis of y to move parallel to itself to the right hand away from the telephonic center T to a new position T' and let Lx denote the distance that the axis moves. Originally, there were $\frac{S}{2}$ stations on each side of this axis. Owing to the motion of the axis, each of $\frac{S}{2}$ stations on the left of the axis will have its line increased an amount equal to Lx units in a direction parallel to the axis of X, and there will be an increase in wire mileage of $\frac{S}{2}\ Lx$ units. As the axis of Y moves to its new position T', it will pass over, or cross, a certain number of stations. Or, in other words, there will be a certain number of stations included between its first and second locations. Let Sm stand for the number of these stations. Then, on one side of the axis of Y in its new location there will be $\frac{S}{2} + Sm$ stations, and on the other side $\frac{S}{2} - Sm$ stations. Owing to the motion of the axis this last number of stations will each lose Lx units of mileage, or there will be a decrease of $Lx\left(\frac{S}{2} - Sm\right)$ miles. Now, to ascertain the *effect* of the moving axis on the mileage of the stations that it crosses during its motion refer to Fig. 18. Let T be the true telephonic center, $Y\ T\ Y$ the axis of Y through that center, and $Y'\ T'\ Y'$ the axis of y in a new position through T' distant $L\,x$ units from T. Let S be any station distant x units from $Y\ T\ Y$ that is crossed by the axis of Y moving to its new position. Then S, when referred to $Y'\ T'\ Y'$ will have a new abscissa equal to $Lx - x$, and the difference between the new and old abscissæ, for S will be $(Lx - X) - x = Lx - 2x$. If there are m groups of stations between $Y\ T\ Y$ and $Y'\ T'\ Y'$ having abscissæ varying from x to xm, these stations will have their mileage increased by an amount equal to

$$S_1(Lx - 2x_1) + S_2(Lx - 2x_2) + S_3(Lx - 2x_3) + \text{''''} Sm(Lx - 2xm)$$

Then, with reference to the new axis of Y the total abscissæ of all stations will be increased by the following quantity:

$$\frac{S}{2}Lx - \left(\frac{S}{2} - Sm\right)1x + S_1(Lx - 2x_1) + S_2(Lx - 2x_2) + \text{''''} Sm(Lx - 2xm).$$

Reducing, —

$$SmLx + S_1(Lx - 2x_1) + S_2(Lx - 2x_2) + \text{''''} Sm(Lx - 2xm).$$

In this expression, S_1 to Sm are the stations crossed by the moving axis. The same reasoning may be applied to the axis of X; hence, to ascertain the effect of a change of location in either axis, it is only necessary to consider the amount that the moving axis will *change the perpendicular distances of the stations that it crosses.* If both axes move, the full solution is obtained by adding the partial

solution for each axis. For any given case, therefore, it is easy to imagine either or both of the axes shifted such varying amounts as will cover all central office sites worthy of consideration, then by substituting numerical values in the preceding expression a curve may be easily plotted, showing the relation between distances from the true telephonic center and increase in line mileage.

In Fig. 19 a concrete example is given. There are 27 stations.

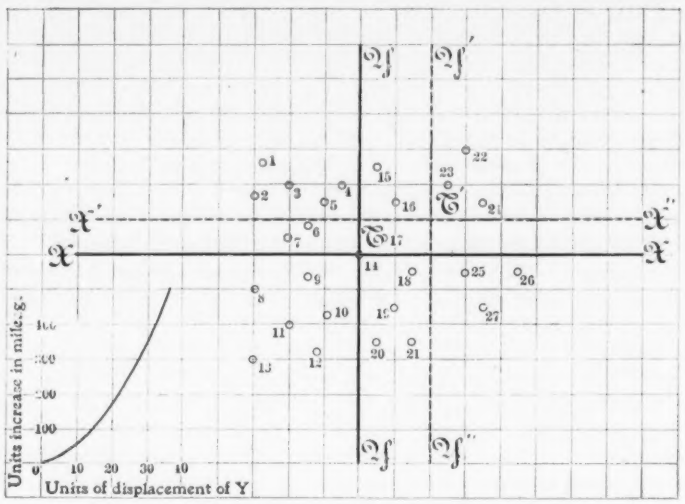


FIG. 19.—EFFECT OF MOVING TELEPHONIC CENTRE.

The axes are shown by the lines X X and Y Y cutting station 14, leaving 13 stations on each side of each axis, giving the true telephonic center at T. Now, assume Y to be shifted 20 units to the right, and X 10 units upward, as shown in dotted lines, to what extent is mileage increased. In Table No. 3 the perpendicular distances of all stations from both the true telephonic center and T and the displaced one T' are given.

TABLE NO. 3.

Effect of Shifting Telephonic Center in Fig. 19.

Station No.	Distance from x x	y y	x' x''	y' y''
1	26	28	16	48
2	17	30	7	50
3	20	20	10	40
4	20	5	10	25
5	15	10	5	30
6	9	15	1	35
7	5	20	5	40
8	10	30	20	50
9	6	15	16	35
10	17	9	27	29
11	20	20	30	40
12	28	12	38	32
13	30	30	40	50
14	0	0	10	20
15	25	5	15	15
16	15	10	5	10
17	5	7	5	13
18	5	15	15	5
19	15	10	25	10
20	25	5	35	15
21	25	15	35	5
22	30	30	20	10
23	20	25	10	5
24	15	35	5	15
25	5	30	15	10
26	5	45	15	25
27	15	35	25	15
Totals	428	511	460	677
Deduct.....			428	511
Differences..			32	166
Add.....				32
Total increase.				198

From this table the X ordinates are shown to be increased 32 units and the Y ordinates 166 units, a total of 198 units. Applying the formula just developed to determine the increase in mileage due to moving the X axis gives the following:

$Sm = 3$

$Lx = 10 \qquad Sm\,Lx = 3 \times 10 = 30$

$S_6 (Lx - 2x_6) = 1\,(10 - 2 \times 9) = -8$

$S_7\,Lx - 2x_7) = 1\,(10 - 2 \times 9) = 0$

$S_{14} (Lx - 2x_{14}) = 1\,(10 - 2 \times 0) = 10$

$S_{17} (Lx - 2x_{17}) = 1\,(10 - 2 \times 5) = 0$

$+2$

$Sm\,Lx \qquad 30$

Total net increase for x..... 32 units

The increase due to the shifting of the axis of y is calculated as follows:

$Sm = 7 \quad Ly = 20 \quad Sm\,Ly = 7 \times 20 = 140$

$S_{14} (Ly - 2y_{14}) = 1\,(20 - 2 \times 0) = 20$

$S_{15} (Ly_{15} - 2y_{15}) = 1\,(20 - 2 \times 5) = 10$

$S_{16} (Ly - 2y_{16}) = 1\,(20 - 2 \times 10) = 0$

$S_{17} (Ly - 2y_{17}) = 1\,(20 - 2 \times 7) = 6$

$S_{18} (Ly - 2y_{18}) = 1\,(20 - 2 \times 15) = -10$

$S_{19} (Ly - 2y_{19}) = 1\,(20 - 2 \times 10) = 0$

$S_{20} (Ly - 2y_{20}) = 1\,(20 - 2 \times 5) = 10$

$S_{21} (Ly - 2y_{21}) = 1\,(20 - 2 \times 15) = -10$

$46 - 20 = 26$

140

Total 166

Increase for shifting of axis of x..... 32

Total increase (check with Table 3).. 198

In the lower left-hand corner of Fig. 19 a curve is given, showing the relation of increase in mileage and displacement of the axis of y in the example of Fig. 19. The vertical scale is changed in wire-mileage, while the horizontal scale is units of displacement. A similar curve could be plotted for the motion of the x axis, while a combination of the two curves would give the resultant of a change in both axes. To completely cover the problem it is necessary to plot two curve for each axis in order to show the effect of motion in each direction. While from the formula and specimen curve of Fig. 19 it is easy to see that, in general, the curve of mileage increase will be parabolic or hyperbolic, differing station density will so change the constant that no general curve can be given, and it is necessary to plot a specific one for each case.

PRACTICAL LIMITATIONS.

While the preceding discussion indicates the method of selecting the central office site, in order to make the wire plant expense a minimum, there are certain practical limitations due to urban topography that must not be completely ignored. The underlying principles can be best illustrated by a concrete example, and as there is no exact mathematical treatment each case must be worked out by itself. In Fig. 20 let the plane of the paper represent any town laid off in approximately rectangular blocks, with 27 stations indicated by the small circles. By the method described the axes will be located at X X' and Y Y', with the telephonic center at T. On the left-hand the streets horizontally are designated by letters from A to E, inclusive, while vertically along the top they are numbered from 1 to 6, inclusive. Theoretically, the wire plant is supposed to extend from the switchboard to the sub-station instrument, practically it would run from the office manhole in the street, near the wall of the office building, to the wall of the subscriber's premises; the inside wiring of both sub-stations and office being excluded from the definition of wire plant. Theoretically, each line is assumed to follow the shortest rectangular route from the office to the sub-station, but practically this is not always possible. Thus, station No. 21 should theoretically proceed west to the line Y Y, and thence north to the center at T. Practically, station 21 must proceed east to Sixth Street, thence north to C Sreet, and hence west to the office. This course is necessitated, as it is ordinarily impractical to obtain access from the street to the premises of a station, excepting through the owners' frontage. Similarly stations 4 and 6 should run directly east to the axis Y Y, and thence south to the office location T. But this is impractical, as they are located in the

center of a block, and cable runs would not be constructed through private premises to reach the office; thus all lines must follow the shortest practical routes to the nearest street, and then be carried through conduits or on pole lines to the office. From inspection of Fig. 20 it is seen that the nearest street points to the telephonic center *T*, where an office manhole could be constructed, are the points *H* and *H'*, and that either of these locations is equally good, so far as length of cable from the manhole to the office is concerned, and it becomes only a question of which of these two points will give the shortest wire routes to the stations. Further inspection shows that for subscribers 4 and 6, there is very little choice between running east on B Street and south on Fourth Street to *H'* or west on B Street to Third Street, thence south to C Street and east on C Street to *H*; for subscribers 14 and 15 the route south on Fourth Street to *H'* is a little shorter than the mileage required to reach *H*, and the same is true for station 8. If *H* is used for the office manhole, the line to station 8 is shortened, while from stations 14 and 15 the lines are lengthened. Contrariwise, if *H'* is used, the lines of 14 and 15 are shortened and to 8 lengthened.

Considering the whole of the territory, it is seen that if all the sta-

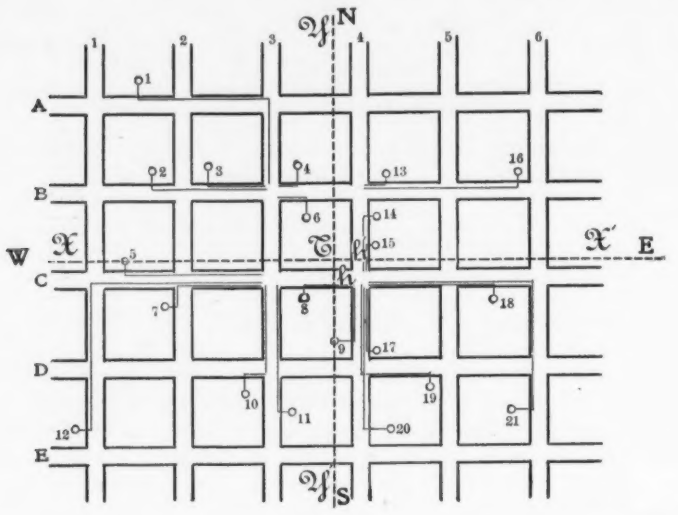


FIG. 20.—PRACTICAL LIMITATIONS IN DETERMINING TELEPHONIC CENTRE.

tions on the west of the axis of *Y*, except 8, are brought to the intersection of Third and C streets, there will be five lines running south on Third Street, three lines east on C Street and two north on Third Street, a total of 10 lines converging to this point. On the east side of the axis of *Y*, to the intersection of Fourth and C streets, there will be four lines proceeding south on Fourth Street, two west on C Street and four north on Fourth Street, a total of 10 lines. If station 8 be included there will be 11 lines from the west and 10 from the east. Similar reasoning may be applied to the stations on each side of the axis of *X*. Now, it is evident that the office manhole may be moved north or south on Third or Fourth streets, or east or west on B or C streets, without materially affecting the total mileage, so long as it is not carried beyond the rectangle formed by these streets. It is also a matter of indifference on which side of these streets the office is located. Hence the practical rule that the office may be located anywhere within a rectangle formed by lots abutting on the streets bounding the block in which the theoretical center is found.

Electrolytic Production of Caustic Alkali.

Patents issued March 11 to James D. Gilmour, of Glasgow, Scotland, and to Edwin D. Chaplin, of Winchester, and Henry G. Halloran, of Boston, Mass., fairly represent progress along the two lines upon which this art has developed—the mercury cathode, and diaphragm, types of cell.

Mr. Gilmour's cell, like that recently patented to Bell, aims to effect the circulation of mercury under the anodes and through the oxidizing compartment without the use of moving parts. Bell utilizes the pressure exerted by the generated gases for accomplishing this movement, whereas Gilmour effects the result by pressure exerted intermittently upon the surface of the mercury by a pulsating pump circulating the caustic solution. The electrolytic cell rests within and slightly above the bottom of the oxidizing chamber, and communicates with it through two conduits provided with oppositely opening check valves, the mercury in the two compartments being in communication through these conduits, and the whole disposition such that pressure exerted upon the surface of the mercury in the outer vessel will cause it to flow upward into the inner or electrolytic cell, returning by gravity to the outer vessel as the pressure is relieved. The caustic lye is forced intermittently through the oxidizing cell, and at each pulsation a quantity of mercury is forced upward through one of the conduits into the decomposing chamber, to flow past the anodes and out from the cell by the other conduit during the succeeding interval. At the same time the surface of the mercury in the outer chamber is thoroughly scrubbed by the caustic solution forced through the narrow channel between the bottoms of the cells.

The second or diaphragm cell is a modification of the well known type developed by Hoepfner, Bein and others, in which the electrodes are separated by two diaphragms retaining between them a neutral body of electrolyte into which the fresh solution is fed, and from which it passes to the respective compartments. In the cell as described, the anode and cathode are laterally separated by an impervious partial partition extending nearly to the bottom of the cell. The base if the cell below this partition is filled with the neutral body of electrolyte, above which, and separating it from both compartments, is a horizontal pervious diaphragm of asbestos cloth. The current efficiency of such a cell producing dilute caustic should be fairly high, but by reason of the devious path of the current within the vessel, the interposition of two diaphragms between the electrodes, and the smallness of the opposed active faces of the electrodes, the internal resistance must necessarily be high and the energy efficiency correspondingly low.

New Telephone Patents.

The issue of March 11, 1902, embraces three patents relating to telephony. One inventor contributes a register to indicate which station on a party line has called the central office, another a combined telephone and fire-alarm system, and a third a telephone receiver support.

Mr. Jefferson D. Hobbs, of Jersey City, patents a telephone substation registering system which has for its object to indicate to the operator by means of a registering dial and a bell signal which station of several on a party line has made a call, thus enabling the operator to charge the call to the proper party. Mr. Hobbs is unkind enough to allege that the party-line subscriber, when making a call which is to be charged against him by ticket, often gives to the operator a number other than his own. The invention then is "to provide a simple and effective means for automatically registering the number of an instrument when the same is used and thereby avoiding

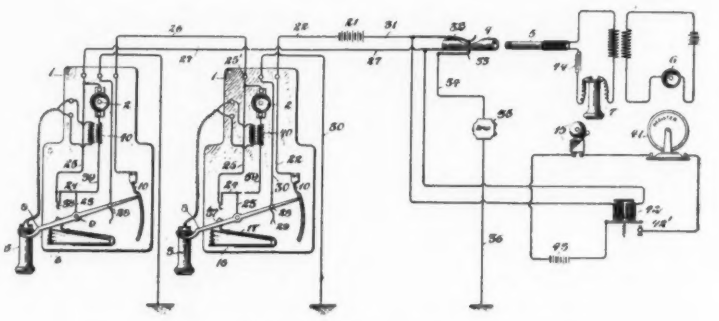


FIG. 1.—HOBBS' TELEPHONE REGISTERING SYSTEM.

possibility of fraud and deceit being practiced, as referred to." Mr. Hobbs makes the indication of the number occur at the end of the call by causing the switch-hook to pass over a sub-divided contact plate and so transmit a series of impulses to a relay controlling the register. A bell in the local circuit of the relay gives audible indication of the registration.

Referring to the diagrams, the switch lever 8 makes contact at its inner end with a curved plate 10 having two grooves in its surface, these grooves crossing at the top of the plate so that the point of the lever goes down one and up the other in its two movements. The down groove is clear and the up groove is interrupted by insulating bushings 14, 14; therefore, when the receiver is taken off and the lever moves its inner end down it makes uninterrupted contact with 10, and when the receiver is replaced moving the point of the lever

up it makes a succession of interrupted contacts, thereby sending impulses from battery 21 to relay 42, which controls register 41 and bell 15. In passing downward the lever 8 by means of pin 28 makes contact with the bent spring 29, and so grounds battery 21 through the drop, making the call. To cause the lever 8 to move with deliberation the bellows 16 is fitted below it.

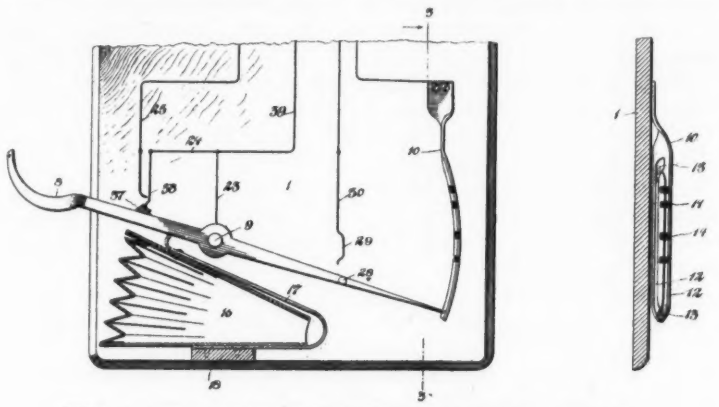
Mr. Hobbs' telephone circuit will hardly pass muster, and as the registering device and bell must be within close range of the operator, one registering machine and one bell for each party line it is not easy to imagine a telephone engineer equipping his switchboards with this device.

Mr. Leonidas G. Woolley, of Kenton, Ohio, patents a telephone and fire-alarm signal the object of which is "to have the telephone automatically turn in a firm-alarm to the central at the same time the occupants of the building are notified, and to so construct the parts that if a person is too nervous to operate the telephone he has only to break the pane of glass in a door of the telephone box, when the alarm is sounded and transmitted to central." Mr. Woolley is his own patent attorney, and his specification irresistibly reminds one of the too true saying regarding a man who is his own lawyer.

Briefly put, Mr. Woolley aims to supply a combination telephone and fire alarm with the object of conveying an alarm of fire to a telephone central office by means of an automatic operation of the alarm either by a thermostat or by breaking a pane of glass that releases a spring-actuated drum which revolves the generator, or by a normal operation of the alarm by hand and subsequent use of the telephone. The gist of the invention is a device by which the armature of the generator is automatically turned when a spring drum is released by a rocking frame normally held in place by the glass door. The frame is held in place by the door, and is consequently rocked either when the door is opened automatically by the action of the thermostat or when the pane of glass is broken.

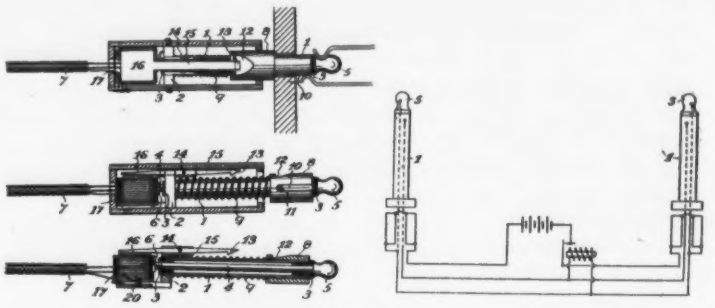
Mr. George M. Beerbower, of New York, patents a telephone receiver support of which the least said the better. The object of the invention is to provide an arm for supporting the receiver so as to admit of the user placing his ear against it and holding his head in any convenient position or moving it (the head) in any direction within reasonable limits while the receiver is kept constantly against his ear, leaving his hand free to take notes or handle memoranda. The money wasted in taking out patents on wholly useless devices of this kind must aggregate a large amount in the course of a year.

A patent issued to Mr. Charles F. Butte, of San Francisco, No. 692,005, of Jan. 28, 1902, which did not reach this office with the



FIGS. 2 AND 3.—HOBB'S TELEPHONE REGISTERING SYSTEM.

others issued on that date, covers an "automatic electric switch" that might better be entitled a self-ejecting plug, as that is the real object of the invention. The plug is fitted with a spring and loose sleeve sliding over the sleeve of the plug. When the plug is inserted in a jack the sliding sleeve bearing against the face of the switchboard compresses the spring and holds it compressed by the engagement of a latch in a notch on the sleeve. The latch is controlled by an electromagnet set in the base of the plug. When this magnet is energized the latch is raised and the spring, being then free to act against the sliding sleeve bearing against the face of the switchhboard, forces the plug out of the jack. The magnet operating the latch lever is included in a local circuit controlled by a relay, which is energized when the subscribers give the disconnection signal. Figs. 4 to 7 illustrate the construction and general idea of the device so clearly that no detailed description is necessary. Whether at busy times in a large switchboard self-ejecting plugs would not cause more confusion and loss of time to the operators than the present method of handling plugs is open to question, as it is comparatively rare for a plug to have a clear course from the jack where it happens to be to its normal seat. At a busy multiple switchboard it seems probable that self-ejecting plugs if left to themselves would soon produce a glorious tangle of cords. If the operator had to guide each self-ejected plug back to its place she would be doing practically as much work as usual. These practical objections, of course, could only be proved by actual trial, but they naturally occur to any one who has watched the operation of a busy multiple board and are entirely apart



FIGS. 4 TO 7.—BUTTE'S AUTOMATIC SWITCH.

from the obvious electrical and mechanical difficulties. In the common battery system, for instance, if the supervisory relays were used to control the ejecting magnets the connecting plug would not stay in until the called subscriber took down his telephone, and in the magneto system any ring on the line would throw out both plugs. How long the mechanism in the plug handle would stand the racket of being dropped from the jack to the keyboard is a point that also suggests itself.

Mr. Marconi in Canada.

Mr. Marconi, who spent last week in Ottawa, is now at Cape Breton. During his stay in the Canadian capital he was chiefly occupied with the negotiations preliminary to the conclusion of the agreement with the Dominion Government, of which we print an account in another column. Mr. Marconi has been, we understand, deeply gratified by the very cordial welcome which he again found awaiting him from the Canadian Ministers, and in government circles no less than from the leading representatives of unofficial society in Ottawa.

Immediately after the signing of the agreement, on Tuesday, March 18, Mr. Marconi, accompanied by his private secretary, left for Nova Scotia. The party, which included also Mr. and Mrs. Vyvyan and an assistant, reached Sydney a day or two later, since when Mr. Marconi has been busily engaged over the final selection of a site for the erection of his transatlantic station in Nova Scotia. This accomplished, and leaving Mr. Vyvyan as resident engineer in charge of the work of establishing the station, Mr. Marconi will return forthwith to New York, where he may probably pass a few days before sailing for England.

CURRENT NEWS AND NOTES.

THREE-CENT FARES.—The Cleveland three-cent street car fare ordinance has been passed finally by the City Council, there being but two dissenting votes. Mayor Johnson, who is interested in the company, stated that operations of building the new lines will begin within a month.

N. E. L. A.—Mr. George F. Porter, secretary of the National Electric Light Association, announces that the twenty-fifth convention of that body will be held at Cincinnati, Ohio, on May 20, 21 and 22. The headquarters of the Association will be at the Grand Hotel, and the rates will be: American plan, $3 per day; European plan, $1 per day and upward. Mr. Porter states that a very interesting and original programme has been arranged, which promises to make this convention particularly interesting and instructive. The Association in all its long and useful career has never visited Cincinnati, and the present opportunity will, it is hoped, be seized by a large number of members.

ELECTROPLATED FABRIC.—The production of copper and silver-plated laces, having the appearance of metal fabrics, flexible or stiff according to the quantity of metal deposited, was one of the earliest appliances of galvanoplastics, and it may be questioned whether the early work in this line has ever been excelled in point of quality. A method employed by Mr. J. A. Daly, of Washington, D. C., the subject of a patent issued March 11 consists in saturating the fabric with a solution of celluloid or other nitrated cellulose holding in suspension a metallic powder; this powder, enmeshed in the fabric, serves as a base for an adherent deposit. The method possesses little novelty, a substantially identical procedure having been patented in England in 1896 by Ash.

A NEWSPAPER DISCOVERY.—The ability of the daily newspaper reporter to make a brand new discovery out of some old and well-known practice is well illustrated by the amount of space recently given in a large Chicago daily to the alleged new discovery by a storage battery maker in that city of the process of cutting steel with the electric arc. Of course, the use of the electric arc as a substitute for the drill has long been known, and as far back as 1895 arcs of large current volume for piercing and cutting heavy metal vault plates and steel girders were practically applied in a workable method by Mr. Clyde J. Coleman at Chicago. Since that time much metal cutting with heavy arcs has been done in that and other neighboring Western cities, and it has proved a great help and time saver in some cases where alterations in steel frame buildings or in large chrome steel vaults have been made.

CHICAGO SUBWAYS.—There seems to be a suspicion that the superb subways of the Illinois Telephone Company, recently illustrated and described in our pages, are too large merely to carry telephone cables, and may ultimately be found devoted to traction purposes. Mayor Harrison is quoted as saying that so far as the size of the proposed trunk-line tunnel was concerned, it would easily accommodate traction lines. But this was not all. He was confronted with the fact that the proposed trunk line tunnel is higher than, and nearly as wide, as the La Salle Street tunnel. He said that it is also larger than part of the New York traction subway. He also noted that the plans of the telephone company provided for a system of these large conduits, which intersected in such a way as to afford an excellent opportunity for their being used as downtown loops for traction companies, should this be desired at a future time. The impression is gaining ground that the telephone company may turn over its franchise to the traction lines, although President Wheeler, of the former, vigorously denies the insinuation.

WATER-WHEEL GOVERNOR.—With the usual form of water-wheel governor, operating simply to open and close a gate, the first effect of such opening or closing is always, owing to the inertia of the water, the opposite to that desired for governing purposes. That is to say, the opening of the gate acts momentarily to cause less velocity of water at the wheel owing to the greater orifice of flow, and the opposite occurs upon closing the gate, these effects lasting until the changed conditions can be imparted to the source of supply of water. To obviate this defect is the subject of a patent granted March 11 to Lamar Lyndon, one of the principal features of which consists in the insertion of a by-pass in the penstock or flume at a point near the water gate, and having a gate controlled by the same mechanism controlling the water gate, which gate or valve operates to allow a greater or less flow through the by-pass as the water gate is being opened or closed. Means are also provided for preventing excessive action of the governor in either direction due to inertia of its parts or other reasons, thereby preventing oscillation on either side of the regulating point. Another feature relates to the control of the governor by a dynamo driven by the water-wheel and so wound that the e. m. f. at the terminals is substantially independent of the load and varies with the speed, but at a rate greater than the speed variation in order to obtain greater sensitiveness in regulation. A clutch connects the by-pass operating device with the water gate operating shaft whereby the by-pass valve is controlled inversely to the water-gate—a controller responsive to the speed of the water-wheel making and unmaking the clutch connection.

WIRE INSULATION.—A patent granted March 11 to Elihu Thomson and J. G. Callan relates to a process for coating wires, and particularly those of small diameter, with a very thin skin of material which is flexible, tough, not easily inflammable and capable of resisting a comparatively high degree of heat. The basic material consists of cellulose tetracetate, which is mixed with a softener and applied in a plurality of coatings. The bare wire is led from a reel and first passed through a very thin solution of Canada balsam, rubber, or other adhesive, which serves the double purpose of dissolving any grease from the wire and covering it with a thin adherent coat, which closely binds to the wire the subsequent coats of cellulose compound. The wire is led from the adhesive coating bath through a drying-box, which may contain hot air. It is then led through another bath and a primary coating of the cellulose compound applied, consisting of a solution of cellulose tetracetate in chloroform or other suitable solvent, mixed with a quantity of Venice turpentine about equal in amount to the actual contents of cellulose acetate in the solution. This gives a coating which adheres closely to the balsam, rubber, or other adhesive film used and binds firmly to the wire the subsequent coatings of insulating cellulose compound. Second, third, fourth, or further insulating coats of the acetate in solution without the admixture of Venice turpentine are applied by subsequent baths, flexibility being imparted to the coating by any of the known softeners added to the solution. Good results have been achieved by adding to the solution a softener composed of five parts, by weight, of castor-oil and fifty of phenol for each hundred parts of solid cellulose acetate contained. The patent describes in detail the arrangement of baths, reel, drying box, scrapers, etc.

AMERICAN ELECTRO-CHEMICAL SOCIETY.—The inaugural meeting of the American Electro-Chemical Society will be held the evening of April 3 at the Manufacturers' Club, Philadelphia. This meeting will be devoted to the organization of the society, the adoption of a constitution and by-laws, election of officers, determining times and places of future meetings, discussing the question of publishing the transactions, etc. Meetings for the reading and discussion of papers will be held Friday morning and afternoon and Saturday morning in the lecture hall of the John Harrison Laboratory of Chemistry, University of Pennsylvania. On Friday evening there will be an informal reception of the members and friends at the Manufacturers' Club. Arrangements have been made for visits to the chemical works of Harrison Brothers & Co., where electrolytic sodium, nitric acid and other processes are in operation; the chemical laboratories of the University of Pennsylvania; the works of the Bethlehem Steel Company; the Lehigh Zinc Works at Bethlehem, Pa.; and storage battery sub-stations of the Philadelphia Electric Company and Union Traction Company. Following is the list of papers to be read: "A University Course in Electro-Chemistry," by Professor Joseph W. Richards, Ph.D., Lehigh University, Bethlehem, Pa.; "Electrodes," by Clarence L. Collins, Niagara Falls, N. Y.; "Note on the Gladstone-Tribe Couple," by Professor Wilder D. Bancroft, Ph.D., Cornell University, Ithaca, N. Y.; "The Nascent State," by C. J. Reed, Philadelphia, Pa.; "The Electrolytic Reduction of Lead," by Pedro G. Salom, Ph.D., Philadelphia, Pa.; "Electrodeless Conduction in Electrolytes," by Carl Hering, Philadelphia, Pa.; "On the Electrolysis of Sodium Nitrate and the Composition of the Developed Gases," by C. W. Volney, Ph. D., Keyport, N. J.; "Current Electro-Chemical Theories," by Professor Louis Kahlenberg, Ph.D., University of Wisconsin, Madison, Wis.; "A Zinc-Bromine Storage Battery," by Herbert H. Dow, Midland, Mich.; "Continuous Electrolysis of Solutions of Metals," by N. S. Keith, Ph.D., New York City; "A Method of Electrolytic Production of Zinc from Its Ores," by Samuel S. Sadtler, Philadelphia, Pa.; "The Electrolytic Rectifier," by Professor C. F. Burgess, University of Wisconsin, and Carl Hambuechen, Madison, Wis.; "On the Relative Speed of the Ions in Solutions of Silver Nitrate in Pyridine and Aceto-Nitrile," by Herman Schlundt, Ph. D., Madison, Wis.; "Fall of Potential in Electrolytes," by Carl Hering, Philadelphia, Pa.; "Caustic Alkalies and Chlorine by the Dry Electrolytic Process," by Charles E. Acker, Niagara Falls, N. Y.; "On a New Type of Electrolytic Meter," by Konrad Norden, Ph. D., New York City; "The Reversible Copper Oxide Plate," by Woolsey McA. Johnson, Hartford, Conn.; "A Thermodynamical Note on the Theory of the Edison Battery," by E. F. Roeber, Ph.D., Philadelphia, Pa.; "Electrolysis of an Aqueous Solution by Alternating Current," by Professor Joseph W. Richards, Ph.D., Lehigh University, Bethlehem, Pa.; "The Atom of Electro-Chemistry," by Arvid Reuterdahl, Providence, R. I.

A TRAIN TELEPHONE SERVICE.—The Chicago & Northwestern, Union Pacific and Southern Pacific will provide a quick service telephone system on the overland trains for the use of passengers arriving at Chicago, Omaha and San Francisco.

LOEB LECTURES ON LIFE.—Under the auspices of the faculty of pure science the ninth annual biological lectures will be delivered by Dr. Jacques Loeb. Dr. Loeb, who is professor of physiology and experimental biology at the University of Chicago, will deliver, in the large lecture-room in Schermerhorn Hall, Columbia University, New York City, at 4:30 P. M., a series whose general subject is "The Dynamics of Living Matter." His particular topics will be: March 18, "The General Chemical Character of Life Phenomena"; March 19, "The General Physical Constitution of Living Matter"; March 20, "Protoplasmic Motion, Muscular Contraction, and Cell Division"; March 21, "The Effects of the Galvanic Current Upon Life Phenomena"; March 24, "The Effects of Ions Upon Various Life Phenomena"; March 25, "The Effects of Light and Heliotropism"; March 26, "Artificial Parthenogenesis and the Problem of Fertilization"; March 27, "Regeneration and the Reversibility of the Process of Development." The lectures are open to the public.

LETTERS TO THE EDITORS.

Mercury Jet Interrupter.

To the Editors Electrical World and Engineer:

Sirs.—Referring to Dr. Max Levy's communication in your issue of March 15, in which he calls attention to the fact that certain desirable features that are present in the type of mercury jet interrupter described by me in this journal, Oct. 12, 1901, exist also in his form of that apparatus, kindly allow me to inform Dr. Levy through your columns that my failure to mention in that paper the various advantages for regulation, etc., that he claims for his interrupter was in no way intended to disparage his apparatus. As my paper was mainly devoted to the description of my own apparatus, for the sake of brevity I dwelt only in a general way, and at that very slightly, upon both the merits and the demerits of other varieties of mercury jet interrupters, and intentionally avoided discussing any of them in detail. Naturally before deciding upon the form of apparatus that I considered more suitable for my needs I carefully looked over all the other designs, and came to the conclusion that all of them, including Dr. Levy's, had certain very objectionable features, although some of them included in their design some very creditable features.

As regards the facility for accurately regulating the duration of contact in Dr. Levy's interrupter, one must admit its convenience, although it appears to me that this feature is more than counterbalanced by the mechanical complexity of the easily derangeable mechanism by which the up and down movements of the jet and turbine are accomplished. It is very evident that upon the least derangement of this mechanism from vibration, rough handling, etc., the central rotating shaft will either jam in its insulating sleeve or cause considerable wobbling of the upright jet and the turbine container, a condition totally incompatible with smooth running and regularity of action. Further, Dr. Levy's arrangement apparently necessitates the use of considerable mercury in order to keep the turbine submerged during its various excursions, and if the glass container is of any size, both the weight of the apparatus as well as the cost of initially charging it with mercury must be large.

Regarding the advantages of using petroleum in these interrupters, I differ decidedly with Dr. Levy. In the first place, its presence causes a prolongation of the arc formed on breaking a circuit containing inductance and capacity, as has been clearly shown by the experiments of Steinmetz. Secondly, even with high flash point oils the apparatus is liable to explode and catch fire. In fact, I have in my possession definite documentary evidence which states that one of Dr. Levy's interrupters exploded and set things on fire and that its further employment was discarded owing to this danger. Thirdly, in a very short time the mercury and the oil from constant churning form a nasty black mud that chokes the pump and jet and puts the apparatus out of action as well as makes the process of cleaning very laborious. As no petroleum is present in my interrupter, only a dry black dust forms, which does not interfere with the action of the apparatus until the expiration of a run of several weeks. This dust can be removed from the machine in a few minutes, and all the mercury contained in it readily recovered for future use.

Regarding the advantages of Dr. Levy's "choking tubes," I confess my inability to criticise as I have never used one. With my large 22-inch coil of special design the simple adjustable spark gaps inserted in series with the tube have always performed their function satisfactorily, and as for the slight hissing they produce, it is practically unnoticeable to most people. Their use certainly steadies the action of the coil and permits this variety of transformer to act as if the secondary was properly loaded, and not overloaded, as it usually appears to be when the terminals of the secondary are connected directly to the leading-in wires of a Röntgen ray tube of low resistance. In other words, probably owing to the effect of capacity, which all large coils possess, and to a more or less continuous flow of current through the tube, especially when the magnetic field of the primary collapses, by interpolating the gaps the e. m. f. at the secondary terminals appears to be able to rise to a pressure sufficiently high to force the current all at once through the tube circuit, whose total resistance vastly diminishes during the momentary arcing which is established at the gaps. With suitably shaped and properly placed discharging points and discs at the gaps, it is not a matter of great difficulty to prevent the make current from traversing the tube. The above arrangement, in my hands at least, certainly does not affect the working of the tube for worse; on the contrary, the tube behaves as if it were actuated by a static machine when the induction coil is actuated by my type of mercury jet interrupter, shunted by a condenser of suitable capacity.

NEW YORK. R. H. CUNNINGHAM, M. D.

Municipal Electric Plants.

To the Editors of Electrical World and Engineer:

Sirs.—The recent discussion in your columns of municipal electric plants, e. g., Detroit, and the suppression of such a project in Worcester, move me to speak my mind upon the subject. The whole matter has been discussed for years with much acrimony and little judicial fairness on either side. Meanwhile experience, much of it very costly, has been accumulating, and ought to be heeded. Personally, I have no prejudice for or against municipal electric plants. In principle a city ought to be able to own and operate its electric light plant just as readily and successfully as its water works. There is no argument against the former that will not apply with almost equal force to the latter case.

Yet, as a matter of pure experience, municipal electric plants have a bad record, and municipal water works a fairly good one. The reasons for this difference form an interesting subject of study. Assuming that a city starts *de novo* and establishes an electric lighting system of its own, it ought in theory to be able to operate it at substantially the same cost as in the case of a private corporation, and take to itself whatever of profit might result. In fact, save in a few small plants, this is not the result, and usually the reason is not far to seek. Instead of buying at a material advantage, and incurring lessened fixed charges, in virtue of better credit and lower rates for interest, the city usually gives up a rake-off on almost every dollars' worth of material purchased and so runs up the cost of the plant that the fixed charges go up instead of down.

It then puts the eight hour law into force and pays the maximum rate of wages to men chosen for their political usefulness—heelers of high and low degree. But assume for the sake of argument a virtuous city government that builds its plant with the same vigorous attention to specifications and bids that would be applied by a private corporation, and puts it under competent and careful superintendence with plenary powers—how then? Aside from the effect of the eight hour law in increasing the pay-roll, the results ought to be good. Sometimes, but rarely, they are; far more generally they are not.

Your analysis of the Detroit situation throws much light upon the subject. First, the plant cannot be kept out of politics for any great length of time, save by rare good fortune. But a better reason can be found in the conditions of financing the plant. You scored, and very justly, the trivial allowance of 3 per cent made for the depreciation in the Detroit plant. Depreciation cannot be treated on the ordinary basis of a sinking fund, for a plant does not mature like bonds or go to pieces at a given date like the famous "One-hoss shay." At best, one would have to deal with a sinking fund affected

by partial payments of uncertain amounts at indefinite intervals, for which feature allowance must be made.

Conceivably such an arrangement at 3 per cent might cover the depreciation due to age and use alone. I have seen putative experts testify under oath to such a rate for apparatus obsolete when they were sworn. But the deadly depreciation due to change in the art cannot be so cavilierly treated, and right here is where the Detroit proposition came to grief. Most of the older electric plants have been practically reconstructed two or three times in their history, and while the apparatus has been steadily improved, improvement has not come to a standstill.

A private plant faces the situation as it best can and pays for replacements out of its surplus, increases its capital stock, or goes through the hands of a receiver according to circumstances. But a public plant which has been administered with an eye to good yearly returns presently finds itself face to face with a big deficit. The searchlight is turned upon its system of accounting, and it has no privacy behind which to hide its blunders. The bald facts come out and the things which many a corporation has done quietly and unobserved, are mercilessly laid bare.

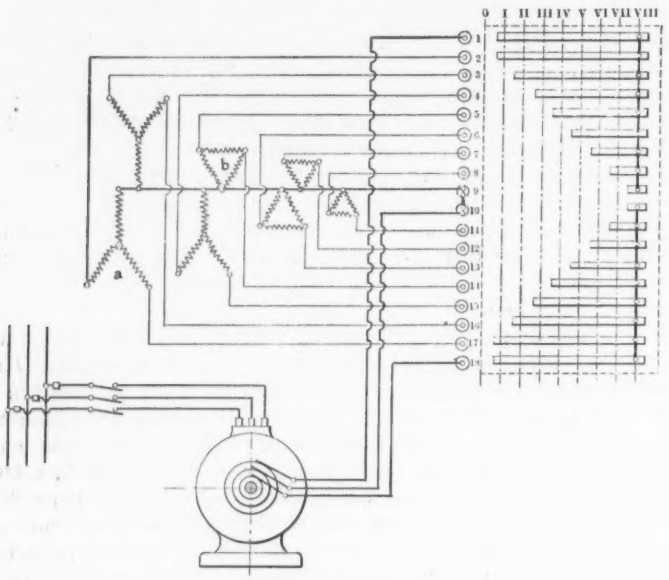
No plant, public or private, can dance to the tune of under-estimated depreciation without paying the fiddler sooner or later. The case is bad enough with private enterprises and has often led to disaster. Public plants, with every temptation to keep down their apparent expenses, are in constant danger from this cause, and when the day of reckoning comes there is nothing to soften the blow. When depreciation is figured with remorseless veracity, the public realizes some of the asperities of the electric lighting business, only too well known to those who have followed it.

Brookline, Mass. Louis Bell.

DIGEST
OF
CURRENT ELECTRICAL LITERATURE.

DYNAMOS, MOTORS AND TRANSFORMERS.

Simplified Three-Phase Current Controllers.—Klein.—An illustrated description of several modifications of the ordinary three-phase current controller. In the ordinary controller, designed for N symmetrical steps, $3N$ contact knobs are used and $3N+3$ wires for the connections between these contact knobs and the motor and its starting resistances. The adjoining diagram shows a controller which is



THREE-PHASE CURRENT CONTROLLER.

much simpler, in so far as only $2N+2$ contact knobs are required and $2N+2$ wires for connections between these and the motor and its starting resistances. In the diagram N is 8. The eight different steps are obtained by moving the right-hand part of the diagram, marked at the top O, I., etc. VIII, to the left hand, so that gradually the 18 contact knobs, 1, 2 . . 18 are connected in various ways. It will be seen that a number of resistances are here rigidly connected in star fashion, for instance, *a*, or in delta fashion, for instance, *b*, and connected, through the contact knobs 9 and 10, to one slip ring at the three-phase rotor. By moving the controller gradually through the different steps, the various resistances are gradually connected in parallel; finally, the rotor is short circuited. He also gives arrangements for cranes, with rotation in both directions, and also describes the controller of a car for a three-phase tramway, which is said to have given satisfactory results in trial runs. The article is well illustrated.—*Elek. Zeit.*, Jan. 23.

Surging of Alternators in Parallel.—Foeppl.—A long, mathematical article in which he develops a theory of the phenomenon of surging of two alternators working in parallel, the period of the occurring oscillations being relatively long—several seconds. He finds that surging can occur only because the connection of the two machines is not entirely rigid, but the coupling is always somewhat elastic so that one machine can lead somewhat before the other, with the result that a resistance of an elastic kind then acts upon the former. He gives the full mathematical theory of the phenomenon under certain suppositions, concerning the causes. He has not tested his theory by experiments. If experimental tests will prove that no essential points are neglected in his theory, the formulas reached by him would give a simple remedy, against surging, by means of variations of details in the design in various ways.—*Elek. Zeit.*, Jan. 23.

REFERENCES.

Shunt Regulating Rheostat.—Krause.—An illustrated description of a simple method for calculating the number of the steps and the size of the steps of a rheostat for regulating the voltage of a shunt machine. It is only necessary to determine some points of the voltage curve at no load in the neighborhood of the normal voltage, and the exciting current for maximum load and normal voltage. The method is illustrated by a numerical example.—*Elek. Zeit.*, Jan. 23.

Reversing Starting Switch.—Levy.—A communication in which he makes some remarks on a recent article by Krause on this subject and calls attention to a reversing starting switch of his own.—*Elek. Zeit.*, Jan. 23.

Progress in Electric Machinery in 1901.—Loewy.—A summary of very many inventions and improvements, made in 1901 by various inventors, taken from patent specifications and articles in journals.—*Zeit. f. Elek.*, Feb. 9.

LIGHTS AND LIGHTING.

REFERENCES.

Railroad Station Lighting.—Jordan.—An illustrated description of the electric lighting installation of the Souther railroad station of Vienna. There are 41 arc lamps fed by alternating current, partly by the three-wire and partly by the two-wire system. The switchboard is described in detail.—*Zeit. f. Elek.*, Feb. 16.

Nernst Lamps and Arc Lamps.—An article with several tables in which it is shown that the Nernst lamp is not only much more economical than the ordinary incandescent lamp, but may also successfully compete in some cases with arc lamps.—*Elek. Anz.*, Jan. 19.

Electric Headlights.—An illustrated detailed description of electric headlights on the Chicago, Milwaukee & St. Paul R'y.—*El'ty*, Feb. 26.

TRACTION.

Electric Traction on Railways.—Mordey and Jenkin.—An abstract of a paper read before the (Brit.) Inst. Civ. Eng. They first discuss direct-current methods. The principal alternative to the simple 500-volt, two-wire system is the three-wire system in various modifications. The City & South London R'y is the only important example in actual practice of a purely direct-current system using other than

the simple 500-volt arrangement. It is a three-wire distribution combined with feeders supplied at 2000 volts. They then deal with the combined direct and alternating-current system and the pure alternating-current system. They discuss the increase of resistance of the rails with alternating currents and the return of energy to the line when running down gradients and when stopping. They say that the following requirements should be met in any general system of electric railway working: "Extra high pressure for feeding sub-stations; avoidance of moving machinery in the sub-stations; on larger lines a high-pressure distribution to the trains, making necessary overhead conductors; easy extension of distributing system; ability to supply trains having different systems of motors and control; high acceleration when starting; the return of energy on gradients or when stopping; possibility of using different speeds; a variable ratio arrangement for starting, for speed regulation and for returning energy; possibility of using motors on a locomotive or distributed on the train; the train equipment and control to admit of extension and modification to work on other systems." The only method which fulfills all the conditions, is the single-phase alternating-current system. They describe a method in which a single-phase motor on the train drives a direct-current dynamo provided with means for separately exciting it and for varying its e. m. f. over any desired range. The current from this dynamo is to be taken to a separately excited direct-current motor. By this means there is provided a most flexible variable ratio transformation.—Lond. *Elec.*, Feb. 28.

An editorial criticizing several points in this paper. It is doubted whether the single-phase system described at the end of the paper will prove satisfactory. It is pointed out that every train would have to carry treble the amount of machinery which would otherwise be necessary.—Lond. *Elec. Rev.*, Feb. 28.

Providence, Warren & Bristol Railway.—A description of the branch line between Providence and Fall River, a distance of 20 miles, with a short branch at Warren running to Bristol. The power station is situated at Warren midway between the termini. It is equipped with two 850-kw, 625-volt generators, direct connected to two cross-compound condensing engines. Before the plant was running, a temporary power station was built adjoining the foundation which consisted of two 500-kw, 550-volt generators, belt driven from an old mill engine. This temporary plant is still used at times of heavy load. The circuits are kept distinct, a 550-volt current being used on the sections near the power house and 625-volt feeders going to the distant ends. Storage batteries are provided near each end, there being two duplicate batteries of 800 ampere-hours capacity each. The motor cars are equipped with four motors, each of 80 hp capacity, making 320 hp capacity per car. Cars are run in trains of two or three each, although single passenger coaches are sometimes operated. The motor cars are equipped with two trolley poles, cow-catchers under the platforms and air brakes. The trolley wire is supported from long ears, which are bent over it before it is soldered in place. The overhead work is both span wire from poles at the side and bracket construction. But one insulator is used between the trolley wire and the ground, viz., that above the trolley ear. Since the road was opened, the schedule time has been considerably reduced from the old steam trains which were formerly operated on this branch and the number of stops have been greatly increased.—*St. R'y Jour.*, March 1 and Int. Ed., March.

Paris.—DETROYAT.—An abstract of a paper read before the Int. Soc. of Elec., on the Metropolitan R'y, of Paris. Direct current at 550 volts is used for driving the trains, and also for lighting the tunnels, trains, shops, etc. The power plant now contains one 1500-kw direct-current railway generator and two three-phase, 1500-kw, 5000-volt alternators. The station thus feeds the adjacent section of the line, and sends three-phase currents to a sub-station, which contains three 750-kw, six-phase converters. Both stations include a "storage battery of 1600 ampere-hours capacity, and for a maximum current of 3000 amperes." He showed how the Metropolitan system can be fed from other stations, which helped greatly in the early starting and regular running of the traction service. Four-car trains and 7-car trains are now in service. The latter have two motor cars controlled by one driver by a special system, using two double-motor equipments, which are coupled in series or multiple, by means of one connected cable. The reversal of the motors is accomplished by a special automatic reverser, operated by small wires.—Lond. *Elec.*, Feb. 28.

REFERENCES.

Twin City Rapid Transit Company.—An article giving one of the most complete financial statements of any road so far published. The company is very successful. Great care has been taken in track construction. About a little less than one-third of the total mileage has cast-welded joints, and considerable track has been laid on concrete beams supporting the rails with tie rods about three meters apart. Complete details of the cost of power and maintenance are given for the system. The auxiliary water power plant at St. Anthony's Falls, in Minneapolis, is used to reduce the cost of power, coal being high priced in Minneapolis and St. Paul.—*St. R'y Jour.*, March 1, and Int. Ed., March.

Municipalization of the Vienna Electric Street Railways.—ZIFFER.—An article on the meeting in which the offer of the city to take over the tramway system was accepted.—*St. R'y Jour.*, Int. Ed., March.

Battery in Traction Stations.—An article giving the good results obtained in a particular case with a battery installed in a traction station for smoothing out the peaks and improving the load factor. The result was a very substantial saving after paying all new charges on the new plant. It is the relation of the peaks to the mean load which determines whether or not a battery would be a paying investment.—Lond. *Elec. Rev.*, Feb. 14.

The Lansing, St. John & St. Louis Railway.—An article on this high-speed railway now being built in Michigan. The especially interesting feature of the road is that the experiment will be made on it with a single-phase alternating motor taking current directly from a single trolley wire and running continuously.—*St. R'y Jour.*, Feb. 15, and Int. Ed., March.

Tokio.—An article on the electric railway equipment for Tokio. Twenty-two miles of electric track are to be built there, and the contracts have just been let for the construction of a large power station containing three 1200-kw generators. Power will be transmitted at 6600 volts. The working plans of the station are given.—*St. R'y Jour.*, March 1, and Int. Ed., March.

Automobiles.—A series of descriptions of various types of automobiles, more especially gasoline and steam carriages. Among the electric automobiles is the Ajax runabout. This issue is devoted almost exclusively to these descriptions.—*Sc. Amer.*, March 1.

Automobiles.—MUELLER.—The first parts of a long mathematical article, in which he discusses the problem of utilizing the energy, generally wasted in braking, for recharging the battery, with the use of shunt motors or compound motors, the compound winding of which can be disconnected. No general results are obtained in these parts of the article.—*Centralblatt f. Accum.*, Jan. 1, Feb. 1, 15.

INSTALLATIONS. SYSTEMS AND APPLIANCES.

London.—An illustrated description of recent extensions, made in the plant of the City of London Elec. Lighting Co., which are called in a separate editorial note, "The crowning triumph of continuous current over alternating-current distribution." With an enormous capital expended in alternating-current machinery, this company resolved three years ago to introduce continuous current gradually. Utilized in the first instance to supply a power load as it was demanded, the continuous-current system was then employed instead of alternating current for each new machine required to supply new lighting consumers as well. The five large machines in the new power house have an aggregate capacity of 7000 kw. It is not proposed to place a battery at the generating station, but arrangements are made for the addition of large batteries within the area of supply. The district is now divided up into several small areas, each with a three-wire 2-by-202-volt distributing network of its own. Motor-generators are now on order to enable the alternating plant to assist the continuous-current extensions, and it is probable that the company may eventually use its high-pressure alternating generators simply as transmitters to the furthest areas to assist during times of heavy load, thus enabling the direct supply to be given from the direct-current generators during nine months of the year without any losses due to transformation.—Lond. *Elec.*, *Elec. Rev.*, *Elec. Eng.*, Feb 28; *Elec. Times*, Feb. 27.

Bristol.—A well illustrated article on the new municipal electric plant of Bristol. The system in the old station was single-phase alternating current at 93 periods for incandescent lighting and direct current at 600 volts for public arc lighting. A primary pressure of 2000 volts and a secondary of 105 volts was adopted for the former service. This initial frequency and pressure have been retained as the works grew. Single-phase is still used for incandescent lighting, and there are even a few motors on the single-phase mains, but in addition a fairly good power load at 250 and 500 volts direct current

is developing, and part of the single-phase supply is now given at the double pressure of 210 volts. The total connections of the old stations are equivalent to 3670 kw for private lighting, 156 kw for public lighting, and 732 hp of motors. As extensions were no longer possible, a new station was absolutely necessary, and the idea is to gradually take up all the lighting load for this new station as new plant is required and ultimately to supply power exclusively from the old station. The new station contains three 745-kw alternators, and two 165-kw, 500-volt direct-current machines.—Lond. *Elec.*, Feb. 14.

REFERENCES.

San Francisco.—An illustrated description of the Independent Electric Light & Power Company, San Francisco, Calif. Oil is used exclusively for the generation of heat in the boiler furnace.—*Power*, March.

Pressburg.—Ross.—An illustrated description of this Austrian lighting plant. The three-wire system, with 440 volts between the outers, is used. There are two 88-kw dynamos, and a storage battery giving 1200 ampere-hours, when discharged in 5 hours.—*Zeit. f. Elek.*, Feb. 2.

Electric Equipment of a Factory.—An illustrated description of the electric installation of an oleomargarine factory in Chicago. There are two 125-kw and one 45-kw, 125-volt direct-current dynamo, supplying a 110-volt system for both light and power.—*West. Elec.*, March 1.

Switchboards.—CLOTHIER.—The first part of an illustrated paper read before the Manchester section of the (Brit.) Inst. of Elec. Eng., on "The construction of high-tension central station switch-gears, with a comparison of British and foreign methods." After a brief summary of the chief functions, which a good switch-gear must fulfil, he gives illustrated notes on the general construction. He discusses the flat board, multiple frame, cubicle, basement and keyboard types.—Lond. *Elec. Times*, Feb. 20.

Switchboards.—HURTZBERG.—An article giving brief illustrated descriptions of a large number of commercial and special switchboards. —*The Eng.*, March 1.

WIRES, WIRING AND CONDUITS.

Waterproof Cable.—A description of the "diatrine" waterproof cable, made by a British firm. Next to the core is placed a layer of paper lapped on in the usual way. The paper, which is of the best quality manilla, is somewhat thicker than is ordinarily used, and is impregnated before being applied to the cable. After the lapping is complete, the covering is again impregnated and is then taped. Over the tape is placed a layer of a waterproof material, which is called dialite, and the composition of which is kept secret. The dialite is lapped with tape in the same manner as a rubber-covered cable, and is then vulcanized in steam. The cable is finished with braiding treated with preservative compound in the usual way. The results of tests made by Wordingham are given. The tested cable had a diameter of core over outside of strands of 0.322 inch, over outside of paper 0.461 inch, over outside of tape 0.482 inch, over dialite 0.671 inch, and over outside braiding 0.816 inch. The insulation resistance per mile in water of 42 degs. F. was found to be 158 megs, after 1 minute's electrification; 194 megs. after 2 minutes, 213 megs. after 3 minutes. The capacity was 0.79 microfarad per mile. The cable broke down at 18,000 volts alternating current. Dialite covering is claimed to be thoroughly waterproof. It is said that ordinary lead-covered paper cables are generally improved by the addition of a layer of dialite between the paper and the lead, while in many cases, where the conditions are suitable, dialite might with advantage be substituted for lead.—Lond. *Elec. Rev.*, Feb. 21.

ELECTRO-PHYSICS AND MAGNETISM

Stratifications in Vacuum Tubes.—CROOKES.—An illustrated paper "read before the Prince of Wales at the Royal Society." He gives a review of his researches which were begun in 1884, and describes at length the very great difficulties encountered in getting pure hydrogen in the tubes, as generally mercury vapor diffuses from the pump into the tube. He describes the methods by which he overcame these difficulties. The phenomenon in general is a dark space near the negative pole, and stratifications in the other part of the tube, in the form of a series of "buttons." These buttons are pink in pure hydrogen, while traces of mercury cause a blue color. The changes of the phenomenon with varying degree of vacuum are described. At the end of the paper he gives some very interesting thoretical notes. At the exhaustion necessary to give stratifications, there is a wide, dark space round the negative pole. Here the negative electrons, issuing from the pole with enormous velocity, have sufficient energy to clear a space in front of them to a distance varying with the degree of exhaustion. The pink and blue luminosities show where the electrons and gaseous atoms meet. What he called radiant matter 25 years ago, now passes as electrons, a term coined by Stoney, "to represent the separate unit of electricity, which is as atomic as matter." A chemical ion consists of a material nucleus or atom of matter constituting by far the larger portion of the mass, and a few electrons or atoms of electricity. Many experiments made by him show that the liberated electrons do not behave as a gas—i. e., they have not properties dependent on intercollisions, mean free path, etc. They act more like a fog or mist, are mobile and carried about by a current of air to which they give temporary conducting powers, clinging to positively electrified bodies and thereby losing mobility, and settling on the walls of the containing vessel if left quiet. On the other hand, the crowd of hydrogen or mercury atoms, by virtue of molecular motion and intercollisions, act as gases. Whilst their mean free paths are conditioned by the degree of exhaustion, there may be among them a certain number of actual free paths differing widely on each side of the mean. Under the influence of the e. m. f. and at the right degree of exhaustion, these atoms arrange themselves in groups, while the rushing swarm of electrons driven from the negative pole meet them and render them visible. According to J. J. Thomson, the mass of an electron is about 700 times smaller than that of the hydrogen atom, and as these masses start from the negative pole in a vacuum tube, with a velocity of the order of half that of light, it is easy to see that their heating, phosphorescent and mechanical power must be stupendous. As a free positive electron is not known, he adheres to the original one-fluid theory of Franklin, and says that the negatively charged electron is the atom of unit of electricity. Then a so-called negatively charged chemical atom is one having a surplus of electrons, the number depending on the valency, while a positively charged atom is one having a deficiency of electrons. Differences of electrical charge may thus be likened to debits and credits in one's banking account, the electrons acting as current coil of the realm.—Lond. *Elec.*, Feb. 21, 28.

Electrical Conductivities Produced in Air by the Motion of Negative Ions.—KIRKBY.—An account of experiments which appear to corroborate Townsend's result that negative ions when moving with adequate velocity disintegrate other molecules upon colliding with them and thus generate new ions. This at least must be the case when the pressure is small. On the other hand, the positive ions do not appear to have the same effect.—*Phil. Mag.*, Feb.

Radio-Activity Imparted to Certain Salts by Cathode Rays.—MCLENNAN.—An account of experiments in which several salts, showing no radio-activity as ordinarily prepared, were found to exhibit a very marked radio-activity on being greatly heated after being exposed to cathode rays. With several of the salts a temperature of 100 degs. C. sufficed to exhibit the effect, though with still higher temperatures the radio-activity was more pronounced. The radiation emitted by these salts was found to discharge positively charged bodies, but not those negatively electrified. In no case did it appear to impart a charge to an unelectrified body.—*Phil. Mag.*, Feb.

Path of an Electron.—RIECKE.—An article in which he shows that the path of a cathode ray particle can be calculated in certain simple cases. One case which can be experimentally realized is that in which the cathode consists of a long wire which can be considered of infinite length, placed in a magnetic field whose direction coincides with the axis of the wire. Cathode particles are projected outwards at right angles to the surface of the wire, but the magnetic field bends them aside so that they eventually describe a circular orbit round the wire. This happens when the electric repulsion of the cathode is just balanced by the centripetal action of the magnetic field. The actual path described by the electron is a spiral which asymptotically approaches the circle referred to. The radius of the circle is the smaller the stronger the magnetic field. He connects this with the contraction of the dark space in a magnetic field. The publication of the experimental results is promised.—*Phys. Zeit.*, Feb. 1; abstracted in Lond. *Elec.*, Feb. 14.

Becquerel Rays.—BECQUEREL.—An account of a further study of the transformation of white phosphorus into red phosphorus through the agency of radium rays. He also made a comparison between uranium and radium rays, and found that of the three classes of rays emitted by radium the undeflected and easily absorbed rays are

absent in uranium rays, while both substances have magnetically deflected rays which are easily absorbed, and magnetically deflected rays of great penetration.—*Comptes Rendus,* Jan. 27.; abstracted in Lond. *Elec.,* Feb. 14.

ELECTRO-CHEMISTRY AND BATTERIES.

Electrolytic Chlorates and Hypochlorites.—An abstract of a paper by Foerster and Mueller, which has already been noticed in the Digest. The following editorial comment is made on the results. The fact that by using electrodes of platinum black, they obtained efficiencies approaching the theoretical figures, in conjunction with the fact discovered earlier by Mueller, that the addition of potassium chromate to the electrolyte in some unexplained manner greatly reduces the reduction losses at the cathode, appears to be of great industrial importance. Rapid progress of those industries is expected when the difficulties have been overcome, which are connected with the preparation of durable platinum-black electrodes.—Lond. *Elec.,* Feb. 28.

REFERENCES.

Conductivity of Mixtures of Solutions.—WOLF.—A theoretical discussion of the influences which determine the conductivity of a mixture of two electrolytes, besides the conductivities of the two components; also an account of some measurements.—*Zeit. f. Elektrochemie,* Feb. 20.

Electrolytic Oxydation.—LABHARDT and ZSCHOCHE.—An account of an experimental investigation of a special case of electrolytic oxydation of methyle groups in aromatic compounds.—*Zeit. f. Elektrochemie,* Feb. 13.

Tantalum.—MOISSAN.—An account of experiments in which he obtained tantalum in considerable quantities in the electric furnace.—*Comptes Rendus,* Jan. 27; abstracted in Lond. *Elec.,* Feb. 14

Ricks Lead Storage Battery.—An account of tests with several discharge curves, of this high capacity cell, which was recently noticed in the Digest.—*Centralblatt f. Accum.,* Feb. 1; translated in Lond. *Elec.,* Feb. 14.

Pan-American Exposition.—RABENALT.—An article on the storage batteries exhibited at the Exposition in Buffalo.—*Centralblatt f. Accum.,* Jan. 1, 15.

UNITS, MEASUREMENTS AND INSTRUMENTS.

A Method for Accurately Measuring Large Phase Differences.—BRESLAUER.—An illustrated paper, read before the Vienna Electro-Technical Society. For measuring phase differences the wattmeter is unsuitable, if the power factor is below 0.1. There are, however, important cases in practice where large phase differences must be measured, for instance, in no load tests of induction motors, where the power factor is between 0.1 and 0.3, and in testing the quality of sheet iron, where it is necessary to determine power factors exactly down to 0.08. The method described by him is based upon the measurement of sum and difference of the instantaneous values of the e. m. f.'s. In Fig. 1 *A* is the apparatus, the watt consumption of which is to be determined; *R* is a non-inductive resistance in series

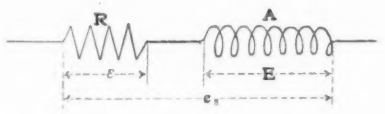


FIG. 1.—DIAGRAM OF CIRCUITS.

with it. He determines the geometrical sum *M* and the geometrical difference *N* of the two voltages lost in *A* and *R*. The power consumed in *A* is then equal to the difference of the squares of *M* and *N*, divided by 4 *R*. For determining *M* and *N* he uses a differential galvanometer; i. e., any electromagnetic instrument with two windings of exactly the same position in regard to the iron core. Any such instrument with a coil in which an iron core oscillates, can be used for this purpose when the coil is unwound and rewound with the same wire bifilarly. The connections of the instrument are shown in Fig. 2. By exchanging the connections of one of the coils, either *M* or *N* are measured. Still simpler and more suitable for practical purposes is the use of an ordinary voltmeter with iron core, which, however, has a series and a shunt winding, so that the latter can be connected in the same or in the opposite direction to the series winding. The theory of the instrument is given. Numerical examples are added,

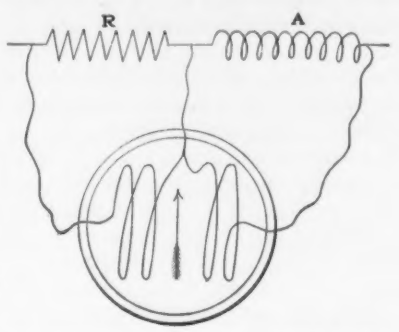


FIG. 2.—CONNECTIONS OF INSTRUMENT.

and it is said that power factors down to 0.07 can be easily measured with sufficient exactness.—*Zeit. f. Elek.,* Feb. 2.

Technical Terminology.—An anonymous pleading for more strictness in the ordinary language of electricians. Kw-hour and kw should not be mixed up. A "recording wattmeter" is a watt-hour meter. Similar mistakes are often made with candle-power. Instead of voltage he recommends the term pressure. He recommends the more general use of conductance, as reciprocal of resistance, and conductivity as reciprocal of resistivity.—Lond. *Elec. Rev.,* Feb. 14.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Musical and Talking Arcs.—DUDDELL.—An abstract of a lecture delivered before the Royal Inst. He showed the talking and whistling arc which made audible the words and the tunes communicated to a telephone in a distant room. He demonstrated Ruhmer's method of wireless telephony. The light of an arc whistling in another room in response to a telephone was directed on to a selenium cell in the theater. A current through the selenium varied in accord with the alternations in intensity of the beam, and these variations reproduced the original sounds in telephone receivers. He further demonstrated syntonic wireless telegraphy. The shunt circuit of a musical arc represented the sending station. A similar circuit at some distance, played the part of a tuned receiving station; and a small incandescent lamp in this latter circuit indicated the receipt of etheric messages. While oscillations of the right frequency, gauged by the note emitted by the arc, existed in the sending circuit, the lamp glowed brilliantly; but if a frequency of a tone above or a tone below was used, the lamp shone but dully, while a note two tones above or below produced no visible effect at the receiving station. He remarked that the full advantages of syntony cannot be obtaind when the oscillating currents in the sending circuit die down repeatedly, as happens when sparks are used to create them, and he suggested it might become the lot of the musical arc, in the perfected tuned telegraphy we are waiting for, to produce the sustained oscillation so desirable.—Lond. *Elec.,* Feb. 28.

Paternity of Wireless Telegraphy.—An illustrated article giving historical notes. The invention of the coherer is due to Onesti, who investigated its properties in 1885. Blondel in 1898 and Tommasino in 1899 first suggested the use of a combination of one coherer and a telephone, and Guarini described the first arrangement with a telephone and another coherer. Numerous other inventions are also noticed.—Lond. *Elec. Eng.,* Feb. 24.

REFERENCES.

Block Signals.—KOHLFUERST.—The first part of an illustrated article on automatic electric block signal systems for main railroads.—*Zeit. f. Eleck.,* Feb. 16.

Wireless Telegraphy.—SULLIVAN.—An article giving some historical notes and discussing the well-known disadvantages of wireless telegraphy.—Lond. *Elec. Rev.,* Feb. 14.

MISCELLANEOUS.

Electric Shocks.—TROTTER, ASPINALL, WEBBER.—Three papers read before the (Brit.) Inst. Elec. Eng. Trotter's paper deals with electric shocks at 500 volts. He says that 500 volts have been deliberately chosen because this pressure is not dangerous under ordinary conditions. Dry wood and dry boots without large nails offer so great resistance to electric current that it is perfectly safe to touch a trolley wire while standing on a dry tram car, or even while standing on the ground, or on the rails. Wet weather makes a considerable difference.

but boots must be very wet to allow enough current to pass to produce a severe shock. Dry clothing offers so great a resistance that no shock can be transmitted through it. With sound dry boots hardly anybody can feel a shock when standing on the live rail of an electric railway with one foot and a running rail with the other. With damp or wet boots a shock is felt, but neither the sensation nor the degree of wetness of the boots can be measured accurately. It is not possible to receive a shock by sitting or lying on a live rail so long as the clothes are dry and continuous and the live metal is not touched by the bare skin. Aspinall's paper deals with the physiological effects of electric shocks in general. Not only are different people differently affected, but the same person under different conditions does not feel the same. A diseased person may be either more or less susceptible, according to what disease one may be suffering from. The path which the current takes through the body is of great importance. The left side of the human body seems to be more vulnerable. The area of contact is of great importance. Burning seems to be to a certain degree a protection against fatal shocks, as the burning not only numbs the nerves, but also increases the resistance. If death occurs from an electric shock, direct current and alternating current are equally dangerous; but if death occurs from burns the direct current is more dangerous. He suggests that an electric shock acts somewhat like an anæsthetic, such as chloroform. He refers to the fact that "in two cases of an electric shock where death would have been expected, the men recovered, in the writer's opinion, from the head being lowered, thus flushing the brain with blood, which is exactly what the doctors do when they want to revive a patient who has collapsed when under chloroform." He says, however, that his evidence on this point is not yet conclusive. The paper by Webber is short, and deals with the legislative side of the question.—Lond. *Elec.*, Feb. 28.

REFERENCE.

Electric Welding of Rails.—HICKS.—A description of the Thomson electric welding process for making rail joints.—*The Polytech.*, Feb. 28.

New Books.

THE RÖNTGEN RAYS IN MEDICINE AND SURGERY. By Francis H. Williams, M. D. New York: The Macmillan Company. 658 pages, 390 illustrations. Price, $6.

Dr. Williams, a well-known expert in the science and art of radiography, has produced a volume destined to be of great service to the medical profession. In the opening chapter of this book, which is elaborately illustrated, he gives a brief review of what is known at present of the nature and properties of the Röntgen ray, and tells of the experiments that have been made to determine their penetrating power in regard to various substances. These experiments have shown that fats are more readily traversed by the rays than water, while the absorptive power of blood and muscles differs but little from that of water. On the other hand, bone, which contains the heavier elements—phosphorus and calcium—has a markedly greater absorbing power. From investigations made by himself with a number of chemical substances, the author is led to the conviction that by means of Röntgen rays we may recognize some changes in chemical composition induced in the body by pathological processes. Our ability to do this without beaker or reagent, or without disturbing the vital process, he regards as "a step in the application of chemistry and physics to practical medicine which hints at what the future may have in store for us."

The various forms of static machines and induction coils used to produce Röntgen rays are then enumerated and described. The machine employed by the author in his clinical work is of the Holtz form, and has four revolving plate-glass plates 183 cm. in diameter, and four fixed plate-glass plates 193 cm. in diameter. These eight plates weigh about 1000 lbs. It is run by a 1-hp electric motor, and receives its initial charge from an auxiliary machine of the Wimshurst type, with plates 40.5 cm. in diameter. To start the large machine, one pole of the exciter is connected with one terminal of the large machine and the other pole with an armature brush on the opposite side of the large machine. To permit the use of a considerable length of spark-gap and at the same time ensure, for purposes of examination with the fluorescent screen, a perfectly steady light, he uses a device of his own, a "multiple spark-gap," which consists of a series of small brass balls 1.25 cm. in diameter, fastened about 3 mm. apart along the edge of a strip of vulcanite 1 cm. wide. This strip, with its balls, is free to move up and down through a vertical brass tube.

Where a machine of smaller size is wanted, the author recommends Elihu Thomson's dynamostatic machine, which has the additional advantage of being less influenced by moisture than the Holtz machine.

The tubes that have proved most satisfactory, both for static machines and coils, are made in accordance with the directions of Dr. Rollins—the double-focus tubes of the cooled target type or the rotary target type.

Much space is devoted to the application of the Röntgen rays to the diagnosis of diseases of the lungs and heart, and especially to tuberculosis, pneumonia, pleurisy and new growths. In other chapters thorough consideration is given to deformities, congenital and acquired, of the skeleton, fractures and dislocations, foreign bodies, diseases of the joints and dental apparatus. The therapeutic uses of Röntgen rays, and especially the action on micro-organisms in the tissues, are fully discussed, of particular interest being the pages dealing with the treatment of lupus and cancerous growths on the surface of the body.

The last chapter, on the examination of food and drugs, and on veterinary medicine, is very brief and fragmentary.

THE ENGINEERING INDEX. Volume III., 1896-1900. Edited by Henry Harrison Suplee, B. Sc., assisted by J. H. Cuntz. New York: The Engineering Magazine. 1030 pages. Price, $7.50.

Recognizing that "next to knowing a thing comes the faculty of knowing where to look for it," various attempts have been made from time to time to compile indices of literature bearing on various lines of knowledge. These attempts have been made by individuals, by societies and by publishing houses. Every wideawake man has a more or less elaborate scheme for keeping notes and references to important papers relating to his work, and, indeed, no publication will obviate the necessity for keeping such notes. But the range of literature is so wide that no person can pretend to keep thoroughly posted even along a single line of engineering unless he spends a disproportionate amount of time and money in simply reading what others are doing, and even then he may miss important articles in papers not at hand.

To meet the evident demand for a published index of current literature, various attempts have been made with more or less success. The Royal Society (of England) Catalogue of Scientific Papers, filling eight quarto volumes of a thousand pages each, lists scientific papers in many languages covering the period from 1800 to 1873, but it excludes technical and professional papers. Poole's Index covers current literature of general interest, but gives little attention to technical publications. The two volumes of Galloupe's Engineering Index covered about 25 American and British engineering journals during the period from 1883 to 1892. The indices in the *Transactions* of the American Institute of Electrical Engineers, in *Electrical Engineering* and in *Electrical Power* were excellent but short lived. Several of the European electrical journals have tried for shorter or longer periods printing lists of contents of their contemporaries. The quarterly *Fortschritte der Elektrotechnik* has covered electrical fields since 1887 with some satisfaction to those who read German, giving references to the important articles in the electrical press and abstracts of selected articles. Originally published several years behind hand, it has now caught up to the extent that the 1900 volume lacks only one number, while one number for 1901 is at hand. The digest in ELECTRICAL WORLD AND ENGINEER has furnished for the past nine years an increasingly valuable weekly digest of important articles on electrical subjects, but it does not aim to be a comprehensive index.

The honor and credit of achieving real success in keeping up an index along comprehensive lines belongs to the management of the *Engineering Magazine*. This magazine has continued and enlarged the index formerly conducted by Professor J. B. Johnson, published in the *Journal* of the Association of Engineering Societies, and collated in two volumes, Volume I. covering the years 1884 to 1891, and Volume II. covering the years from 1892 to 1895. The "Editor's Exchange Table," in the first issue of the *Engineering Magazine*, in April, 1891, gradually developed into so comprehensive and meritorious an index of engineering papers, that the index of the *Journal* was no longer a necessity, and the association abandoned its index with the understanding that the magazine was to continue it and also

to publish a compiled volume about every five years. To indicate the growth in the scope of the work, it is noted that while Volume II. contains about 6000 entries from 62 sources, Volume III. contains nearly 40,000 entries from nearly 200 sources. For a number of years the monthly index has been reprinted with one side of the paper blank, so that entries might easily be cut and pasted on slips for card catalogues. Those who have found these cards accumulating in geometric ratio with a corresponding amount of work in preparation and classification, will be relieved to learn that it is proposed hereafter to compile and publish an annual volume. It is to be hoped that the present volume will meet so cordial a reception as to warrant the publishers in fulfilling their promise of annual volumes.

To indicate something of the scope of the present volume of the index, it may be noted that of the 1030 pages, 6 are given to accumulators, 5 to acetylene, 20 to bridges, 17 to car, 24 to coal, 4 to dams, 3 to education, 122 to "electric," including 6 pages of electro-chemistry, 28 to gas, 10 to heating, 52 to railway, 8 to steam engine and 8 to telephony. Each page gives a number of cross references, which greatly increase the virtual number of references. Each entry gives the approximate length of the article, a brief note regarding its contents, name and date of the publication and frequently the name of the author. References to articles in foreign languages give a free translation of the subject, followed by the exact title in the original, making it more readily found. It is to be regretted that volume and page references are not also given, for dates are often inconspicuous and troublesome to find in the bound volumes.

The classification of engineering knowledge is a difficult problem. The monthly installments in the *Engineering Magazine* have the references classified conveniently under eight or ten different lines of engineering, which, however, overlap to some extent and sometimes require a searcher to look through two or more sections to find the desired entry. In the compiled volume the number of cross-references necessary with any such arrangement would become burdensome, and, therefore, all the entries are made under a single alphabetical arrangement so far as is practical.

The mechanical execution of this volume is excellent. At the top of each page are placed catchwords in bold-faced capitals, indicating the first and last main topics considered on the page. In the text, the main topics are indicated by catchwords in bold-faced capitals and sub-titles are indicated by bold-faced lower case type. Numerous cross-references increase facility in finding desired entries. For example, under *Electric Resistance* will be found cross-references to *Electric Conductivity, Electric Instrument, Electric Measurement, Electric Testing, Rheostat.*

In a monumental work of this character, it would be indeed surprising if there were not a number of typographical errors. Examination, however, shows it to be remarkably free from misleading errors. One occasionally finds a single incorrect letter in a proper name. The work, as a whole, is worthy of the highest commendation, and it will prove a valuable addition to any library.

Directory of Electrical Societies, Etc.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Annual business meeting, New York, May 20; annual convention, Great Barrington, Mass., June 17-20, 1902.

AMERICAN STREET RAILWAY ASSOCIATION. Next meeting, Detroit, Mich., Oct. 8, 9 and 10, 1902.

ASSOCIATION OF RAILWAY TELEGRAPH SUPERINTENDENTS. Next meeting, Chicago, June 18, 1902.

ASSOCIATION OF THE EDISON ILLUMINATING COMPANIES. Next meeting, September, 1902.

CANADIAN ELECTRICAL ASSOCIATION. Next meeting, Quebec, June 11, 12 and 13, 1902.

ILLINOIS INDEPENDENT TELEPHONE ASSOCIATION. Next meeting, Chicago, April 9 and 10, 1902.

INDEPENDENT TELEPHONE ASSOCIATION OF WISCONSIN. Next meeting, Waupaca, Wis., June 25, 26 and 27, 1902.

INTERNATIONAL ASSOCIATION OF MUNICIPAL ELECTRICIANS. Next meeting, Richmond, Va., Oct. 7, 8 and 9, 1902.

NATIONAL ASSOCIATION OF MANUFACTURERS. Next meeting, Indianapolis, Ind., April 15, 16 and 17, 1902.

NATIONAL ELECTRIC LIGHT ASSOCIATION. Next meeting, Cincinnati, Ohio, May 20, 21 and 22, 1902.

NEW YORK STATE STREET RAILWAY ASSOCIATION. Next meeting, Caldwell, N. Y., Sept. 9 and 10, 1902.

NORTHWESTERN ELECTRICAL ASSOCIATION. Next meeting, Waupaca, Wis., June 25, 26 and 27.

OHIO STREET RAILWAY ASSOCIATION. Next meeting, June, 1902.

OLD-TIME TELEGRAPHERS' ASSOCIATION AND UNITED STATES MILITARY TELEGRAPH CORPS. Next meeting, Salt Lake City, Utah, September, 1902.

PENNSYLVANIA STATE STREET RAILWAY ASSOCIATION. Next meeting, October, 1902.

SOUTHWESTERN GAS, ELECTRIC AND STREET RAILWAY ASSOCIATION. Next meeting, San Antonio, Tex., April 18-21, 1902.

New Type of Lundell Fan.

One of the earliest and best known types of that distinctive American product, the fan motor, is the Lundell, made by the Sprague Electric Company, of New York City. Where an article has been

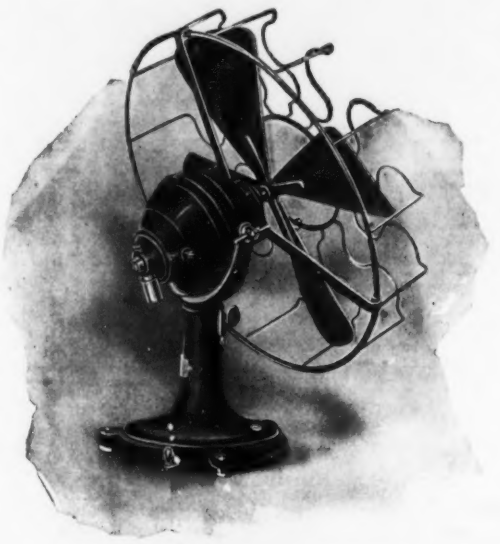


FIG. 1.—TRUNNION DESK FAN.

standardized and perfected through long years of study and experience, it is difficult to make further advances. The handsome fan catalogue for 1902, just issued by the company, shows, however, that

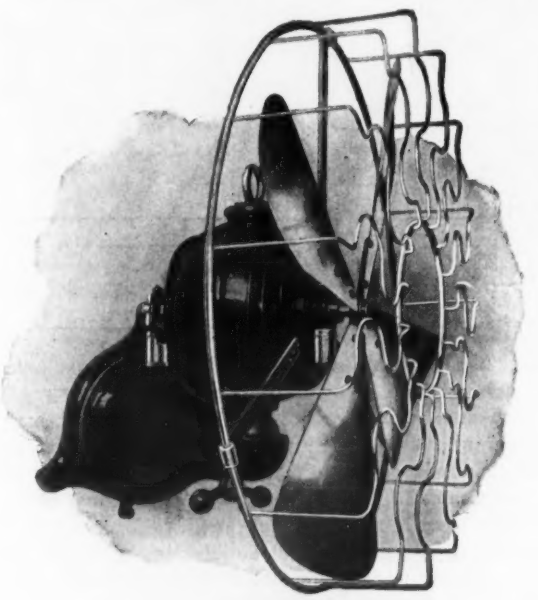


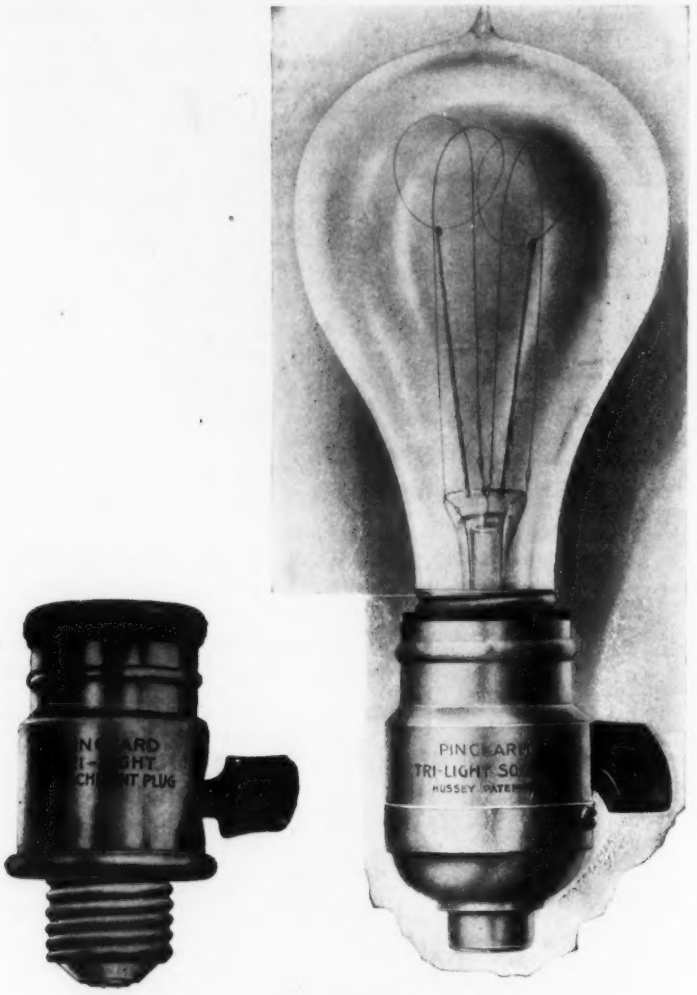
FIG. 2.—BRACKET FAN.

while the old styles remain popular and are, if anything, neater in build and comelier in shape than ever, it has been possible to add to the list of types; and that this season two new models have been introduced, the 12 and 16-inch swivel and trunnion desk fan and the

bracket pattern. They run at three speeds, 800, 1350 and 1900 r. p. m. in the 12-inch size, and 800, 1150 and 1450 r. p. m. in the 16-inch. They have self-aligning and self-oiling ring bearings, and a starting and regulating switch gives variations in speed. With regard to the old models, it may be noted that an increase in efficiency has been effected, the current consumption of the 12-inch, 115-volt motor, being reduced from 0.45 to 0.43 amp. The new types are herewith illustrated.

A New Regulating Incandescent Lamp.

In view of the enormous extension of incandescent lighting, it is only natural that considerable attention should be paid to such regulation of the lamp as will allow its candle-power to be increased or diminished at will, as is done in the case of the gas flame. Even to-day the complaint most often heard in regard to the incandescent light is that we cannot turn it up and down as we do gas. There would certainly seem to be a very large market for a device which should permit this desideratum to be attained, and we illustrate herewith



FIGS. 1 AND 2.—REGULATING LAMPS.

a new socket which aims successfully at the accomplishment of this purpose.

The Pinckard socket or "Tri-light" lamp is being manufactured by the Tri-light Electric Company, of Birmingham, Ala. This socket resembles in appearance the ordinary incandescent lamp socket and is operated in the familiar manner by turning the switch key. At each turn or step in the key movement a different amount of light is obtained. In the case of the double-filament lamp here shown, which is fitted with two filaments of 8 candle-power each, turning the key of the socket once throws these two filaments in series circuit and gives a light of about 2 candle-power; a second turn of the key leaves a single filament in circuit, giving 8 candle-power; a third turn throws in both filaments, giving 16 candle-power. At the fourth step both filaments are thrown out, so that no current at all is taken. It is obvious that by lowering the degrees of candle-power, an economy of current is effected. Any standard Edison base lamp can be used with the Tri-light socket, and Tri-light lamps can be used with any standard Edison socket, only one filament then giving illumination. The lamps are manufactured for candle-powers of 8, 10, 16, 32, 50 and 100.

The key socket is connected to the lighting circuit in the ordinary fashion, and this is true also of the similar wall socket. With keyless sockets holding lamps in places of inconvenient access, a special regulating switch is used, accomplishing the same purpose. Where ordinary sockets are already in use a special attachment plug is furnished which screws into the existing socket and is made with the three standard Edison, Thomson-Houston or Westinghouse devices. These new devices are all economical in purpose and should, it would seem, meet with a large demand wherever it is desired to have a light whose brilliancy can be increased or diminished at will—and there are few places where this is not the case. Mr. Chas. I. Hills, of New York City, is the general sales agent.

Ceiling Fan Development.

The fan season of 1902, now getting into full swing, finds the demand for ceiling fans larger and brisker than ever. We learn from

FIG. 1.—CEILING FAN.

the Hunter Fan & Motor Company, of Fulton, N. Y., that Tuerk alternating current ceiling fans have met with a greater sale this season than ever before, owing to their great economy in the use of current, taking only 100 watts to operate at full speed with a spread of blade of 60 inches and a width of 8 inches. Owing to this fact there

FIG. 2.—COMBINATION CEILING FAN.

has been but very little change in the construction of same for this year, but as there has been a call for a four-bladed alternating fan the company has brought out one. The special feature is that they will run at full speed with a consumption of from 100 to 110 watts with the same spread of blades and on widths as used on the two-bladed fan. They are also supplied with the same spiral grooved oiling system always used, as well as a stopping and starting switch and a blade adjuster which can be used to change the angle on two of the blades while in motion. The other two blades are always stationary at one angle. These fans are furnished to run on any cycles from 40 to 140, and any voltage from 50 to 230.

On the 40 and 50 cycle fans the Hunter Company uses a specially constructed motor which gives a speed of 180 revolutions per minute with a spread of blades of 60 inches and a width of 8 inches, and a consumption of 90 watts of current at full speed.

Electric Fans.

A new line of fan motors is being offered this year by the Fort Wayne Electric Works, Fort Wayne, Ind., the most unique of which is one known as the "Wood" revolving fan motor (Fig. 1), which is of the ordinary high speed type. It consists of a spherically incased motor suspended from a ball bearing so as to revolve around a vertical axis. The case of the motor is small and of light weight, being only 3⅝ inches in diameter and cast of aluminum. The shaft of the motor upon which the fan is mounted is placed at an angle of 45° to the vertical axis of the complete structure. The result is that since the top fan blades are farther from the center of rotation than the lower blades an unbalanced condition is produced, which causes the motor to revolve in a horizontal plane, distributing at intervals the air to all parts of the room.

FIG. 1.—REVOLVING FAN MOTOR WITH CORD SUSPENSION.

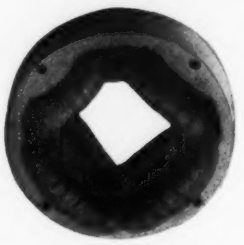


FIG. 2.—FIELD MAGNET ALTERNATING CURRENT FAN MOTOR.

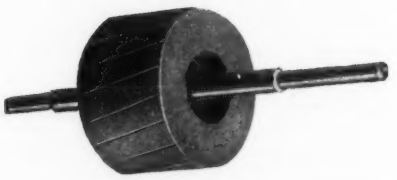


FIG. 3.—ARMATURE OF ALTERNATING CURRENT FAN MOTOR.

FIG. 5.—ARMATURE OF DIRECT CURRENT FAN MOTOR.

The 1902 fan motors are made for both alternating and direct current. The alternating current motor is of the induction type, provided with a four-pole field magnet (Fig. 2) and a squirrel cage armature (Fig. 3). It will be noticed that the slots in the core of the armature are slanted, the object of this being to prevent humming. The direct current motor is provided with a two-pole field magnet (Fig. 4), and a squirrel cage armature of the drum wound type (Fig. 5). The slots in this armature are diagonal to the face of the core, the construction being similar to that of the alternating current armature above described. Carbon brushes of rectangular cross section are used and are mounted in brass tubes into which they fit closely. The brushes are pressed against the commutator by springs that are contained in the tubes immediately back of the brushes, the spring tension being adjusted by means of screws in the back ends of the brush holders. The bearings are of the self-oiling type.

The line of desk type motors (Fig. 6) is similar to the revolving type, with the exception that the motors are mounted on a solid base, the ball bearing suspension being omitted. They are built for both alternating and direct current, and the construction is similar to the revolving type, with the exception above mentioned.

FIG. 4.—FIELD MAGNET OF DIRECT CURRENT FAN MOTOR.

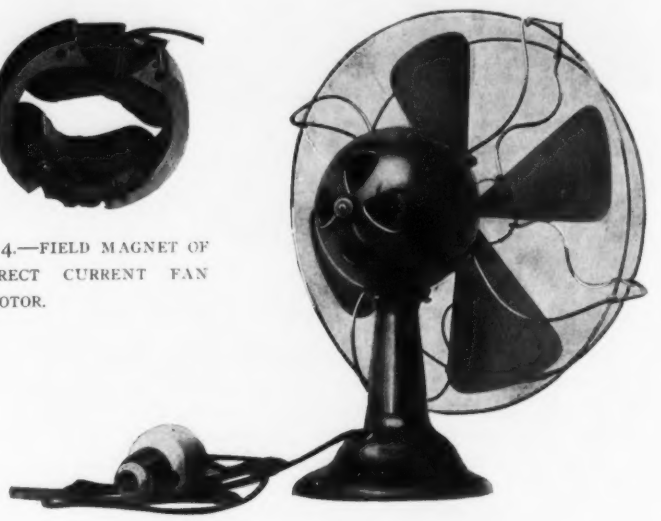


FIG. 6.—DIRECT CURRENT DESK FAN MOTOR.

These machines are all provided with 8-inch fans and run at a maximum speed of 2200 revolutions per minute. The power consumption is as follows: 50-volt motor, 17 watts at 60 cycles, or 36 watts at 140 cycles; 104-volt motor, 17 watts at 60 cycles, or 36 watts at 140 cycles; 115-volt, direct current motor, 17 watts.

Wiring the St. Louis Exposition.

The American Steel & Wire Company, of New York, has been awarded the contract for furnishing for the electrical power circuit of the World's Fair 3,300,000 feet of weatherproof and 43,000 pounds of rubber-covered wire. The contract price is $200,000. Director Taylor has also made public his plans for the great electric subway, which will carry the trunk lines of wire through the main exhibit district of the Exposition. This subway will be 4500 feet long, or nearly a mile in extent. It will be 7 feet high and 7 feet wide, buried some distance beneath the boulevards, promenades and buildings of the Exposition.

It will start from the mammoth switchboard at the big Westinghouse power plant in the western end of the machinery building. The supply cables carrying the current to be furnished by the Citizens' Electric Light & Power Company, four miles away, will also center at this switchboard.

The cables carrying the current will be placed on shelves at the sides of the underground passage, instead of being drawn through ducts. These shelves will run along either side of the subway and will be 18 inches wide. Three feet of space is allowed between, in which the linemen may work. Pump-log conduits will leave the subway at intervals to convey the current to the buildings and to other places where light and power are needed.

Lateral conduits of unusual size will leave the machinery building and the eastern end of the subway and take a straight course for the

cascade gardens, where they will supply the vast illumination for Art Hill and the power to operate the motors and pumps which will take the water out of the grand basin and draw it to a height of 70 feet into the reservoir, which will supply the cascades. The contract for the wire, already let, does not include the cables which will be carried in the subway.

Electrically-Driven Machine Tools.

It is a comparatively simple problem to apply an electric motor to a machine tool requiring only one speed, such as punching machinery. The application of electric motors to this simplest case has,

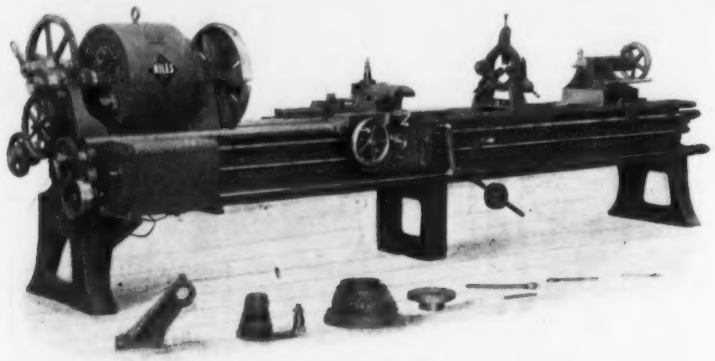


FIG. 1.—LATHE DRIVEN BY ELECTRIC MOTOR.

however, been the means of economizing space far beyond what is ordinarily supposed. For instance, in shipbuilding yards electrically-driven punching machines are installed in any convenient place they can be put, as the power is so readily brought to them. In machine shops they need not occupy space that may be better utilized for other

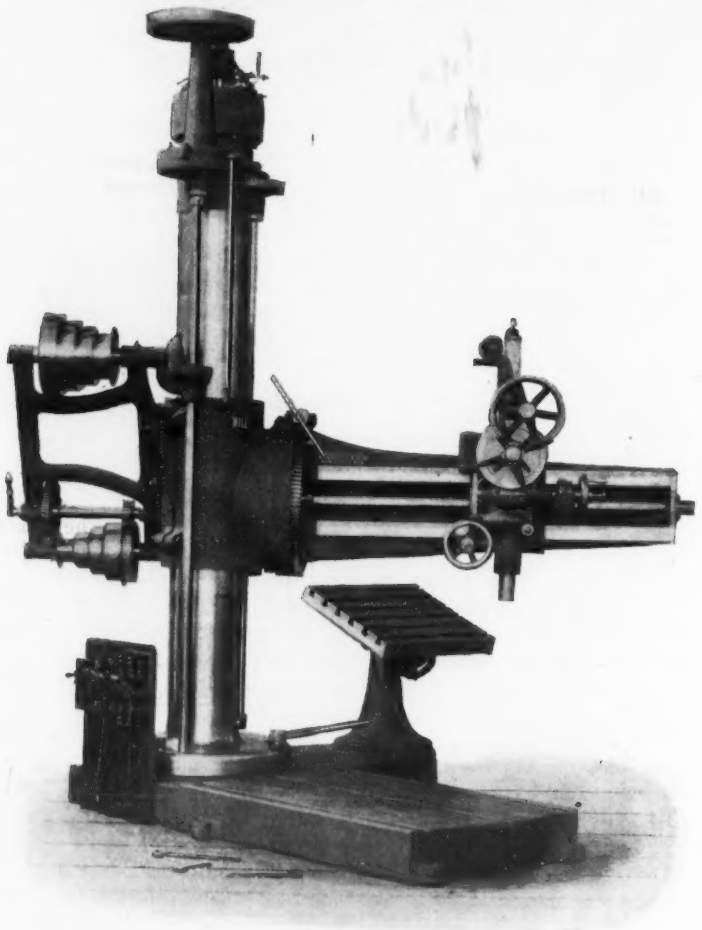


FIG. 2.—ELECTRICALLY DRIVEN RADIAL DRILL.

purposes, but can be set up in odd corners, the motor rendering it possible to run them anywhere.

It is when the motor has to be applied to machines requiring great variety of speeds that the problem presents a more complex aspect. Fig. 1 illustrates a 24-inch lathe built by the Niles Tool Works Company, driven by a Bullock motor. It has 10 changes of speed. The armature shaft is the lathe spindle, and the speed variation is obtained in the motor by means of the three-wire system of multiple voltage.

Fig. 2 is a Niles No. 1 radial drill, driven by a constant speed motor built by the Northern Electrical Manufacturing Company. The necessary variations in the speed are obtained by short belting used on the step pulleys, shown in the photograph. The motor is of the

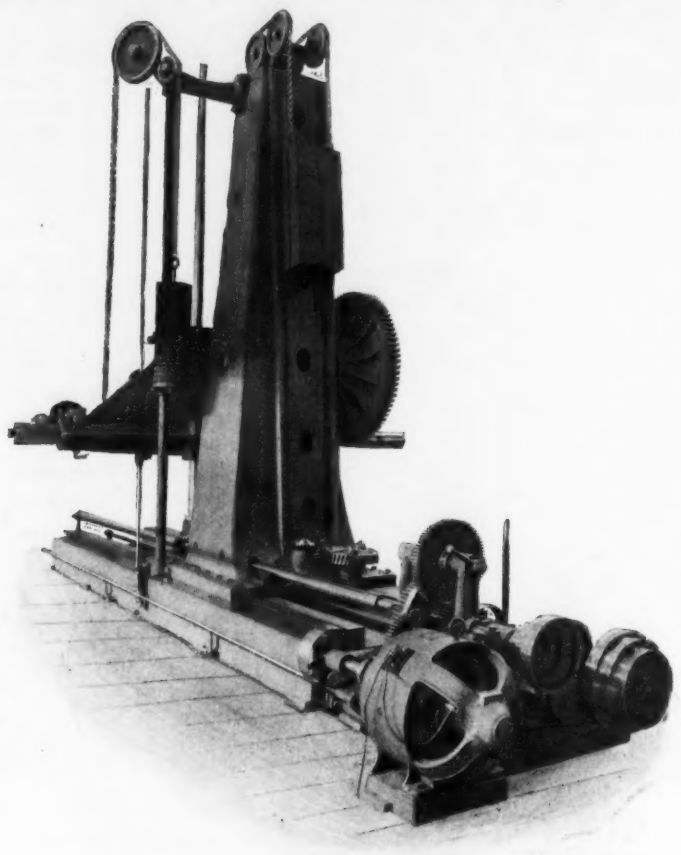


FIG. 3.—HORIZONTAL BORING, DRILLING AND MILLING MACHINE.

vertical type, and drives a vertical shaft, the ordinary cones and back gear being preserved so that a constant speed motor can be used. Ordinarily the switch and rheostat are placed on top of the column and against the motor. In this case, however, as will be seen by reference to the illustration, the switch and rheostat are mounted on a board at the foot of the upright column.

Fig. 3 is a Niles horizontal boring, drilling and milling machine requiring 12 different spindle speeds. The motor, which is built by the Elwell-Parker Electric Company, has in this case a limited speed variation, and is geared to the cone sleeve, two sets of back gears being provided to give the machine the necessary range in speeds.

These three machines illustrate three different methods of obtaining the necessary variations in speed, the change of speed being obtained in the one case in the motor itself, in the second case by short belts acting upon cone pulleys, while in the third the speed is varied partly by the motor and partly by the gearing on the machine itself.

Rosin Solder.

A new product which has recently been placed on the market by the Kellogg Switchboard & Supply Company, of Chicago, is rosin solder. The company has for some time manufactured this material for its own use, it being used exclusively for all its telephone and switchboard work.

Among the advantages of rosin solder for telephone purposes is that there is no acid whatever used in its manufacture or any other material that would tend to corrode soldered connections. It is much cleaner, more convenient, takes up small space and is wound on spools, the same as wire, and therefore can be had in any quantities. The finished product has the appearance of spools of flattened wire, being about one-eighth of an inch in width.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—Time money was in fair demand, and there was plenty of it, the closing rates being 4½ per cent for 30 days to six months. In the stock market there was a strong undertone and prices recovered with ease when subjected to bearish pressure. Speculation, however, was very narrow, specialties and stocks which had pool support furnishing most of the transactions. Amalgamated Copper was a heavy feature, its decline showing more or less uneasiness as regards the next dividend on the stock, although action in the matter has been deferred until the latter part of next month. The traction stocks were a prominent feature, Manhattan in particular distinguishing itself by an advance from 128 to 134¾, and Metropolitan and Brooklyn Rapid Transit also had rises. There was a good deal of manipulation in this group, supposed to be by a pool of prominent Chicago operators. Brooklyn Rapid Transit closed at 65, being a net gain of 1 point, on sales of 40,160 shares. Of Manhattan Elevated 133,400 shares were sold, the closing price being 134¼, a net gain of 4¼ points. Metropolitan Street Railway closed at 167½, being a net loss of ½ point. The highest price of the week was 168¾, the sales amounting to 13,700. United States Steel stocks were supported and showed strength, but did not assume prominence in the trading, notwithstanding the information which was given out on Thursday that it had been decided to issue $250,000,000 5 per cent bonds to retire $200,000,000 preferred stock and provide $50,000,000 for additional working capital. In the electrical list General Electric distinguished itself by reaching the highest point on record for that stock—307—which was also the closing price, representing a net gain of 7½ points. The transactions, however, amounted to only 4600 shares. Westinghouse was also very active and made the remarkable rise at one time of 15 points for the common, and 8¾ points for the preferred. The common stock fluctuated during the week between 181 and 199½, the closing price being 194. The first preferred, of which 300 shares were sold, varied between 190 and 199, the latter being the closing figure. It is difficult to trace the remarkable advance of this stock to any definite cause. There were rumors as to extra dividends, large earnings and probable consolidation with General Electric. Western Union Telegraph was quiet, closing with a net loss of ¼ point, the sales being 2600 shares. American Telephone & Telegraph closed at 84, being a net loss of 6 points as compared with the last quotation. Following are the closing quotations of March 18:

NEW YORK.

	Mar. 11.	Mar. 18.		Mar. 11.	Mar. 18.
American Tel. & Cable...	80	80	General Electric.....	299½	316
American Dist. Tel.....	30	30	General Carriage.....	¼	⅜
Brooklyn Rapid Transit..	63⅜	66⅞	Hudson River Tel.....	—	—
Ches. & Pot. Telephone..	—	—	Metropolitan Street Ry..	167	168¼
Commercial Cable.....	150	150	N. E. Elec. Veh. Trans..	⅝	—
Electric Boat.....	28	7	N. Y. Elec. Veh. Tran...	13	12½
Electric Boat pfd.....	45	45	N. Y. & N. J. Tel.....	—	—
Electric Lead Reduc'n...	1⅞	1½	Tel. & Tel. Co. America..	—	—
Electric Vehicle.....	2¼	2	Western Union Tel.....	90½	91⅜
Electric Vehicle pfd.....	4¼	4	West. E. & M. Co.....	181	195¼
			West. E. & M. Co. pfd...	185	194

BOSTON.

	Mar. 11.	Mar. 18.		Mar. 11.	Mar. 18.
Am. Tel. & Tel.....	162	168½	Mexican Telephone.....	2¼	2½
Cumberland Telephone...	—	—	New England Telephone.	140	145
Edison Elec. Illum.....	—	—	Westinghouse Elec.....	—	—
Erie Telephone.....	—	—	Westinghouse Elec. pfd..	—	98½
General Electric pfd.....	—	—			

PHILADELPHIA.

	Mar. 11.	Mar. 18.		Mar. 11.	Mar. 18.
American Railways.....	—	—	Phila. Traction.....	98	98
Electric Storage Battery..	60	60	Philadelphia Electric....	5¼	4⅞
Elec. Storage Batt'y pfd..	60	60	Pa. Electric Vehicle.....	—	—
Elec. Co. of America....	—	7⅜	Pa. Elec. Veh. pfd.....	—	—

CHICAGO.

	Mar. 11.	Mar. 18.		Mar. 11.	Mar. 18.
Central Union Telephone.	—	—	National Carbon pfd.....	84½	85
Chicago Edison.....	175*	170	Northwest Elev. com....	38½	38
Chicago City Ry.....	215	223*	Union Traction.....	15	17½
Chicago Telep. Co.....	175	185	Union Traction pfd.....	48½	54
National Carbon.....	193¼	211½			

*Asked.

MARCONI'S WIRELESS TELEGRAPHY.—A Marconi company, with a capital of $10,000,000, will be incorporated under New Jersey laws to promote Mr. Marconi's wireless telegraphy system in the United States. Messrs. E. Rollins Morse & Bro. have charge of the financing of the new company. It is proposed to raise $750,000 through the sale of stock, of which amount $250,000 will be paid to the parent company, an English corporation, and $500,000 will go into the treasury of the New Jersey company for development purposes. Details as to the amount of stock to be sold, prices, etc., have not yet been determined upon. Papers relating to the incorporation of the company are now being drawn by Col. John J. McCook, of Alexander & Green. Mr. Marconi, who is now in Canada, estimates that $500,000 will be a sufficient amount to place the American company on a commercial basis. Nothing appears to have resulted from an earlier Marconi company planned and organized in New York some time ago by local financiers.

OPPOSITION TELEPHONY.—The following "inspired" dispatch from Boston says: The recent advance in the stock of the American Telephone & Telegraph Company is attributed to the fact that opposition in New York and the New England States has been squelched through an arrangement entered into in London last summer between President C. F. Cutler, of the New York Telephone Company, and representatives of Mr. Morse, whereby Morse bought in the interest of the Bell people a controlling interest in the stock of the Telephone, Telegraph & Cable Company of America. This was with the understanding that the Erie holdings of the Telephone Cable Company should be turned over to the Western Company, and that all work on the opposition plants in New York and New England should cease. Both of the above agreements have been carried into effect. The two exchanges in Boston and New York are simply maintained with a limited number of subscribers to hold possession of the franchises.

AMERICAN TELEPHONE & TELEGRAPH.—The following is the statement of resources and liabilities of the company Nov. 30, 1901, and of earnings and expenses from Jan. 1, 1901, to Nov. 30, 1901: Resources—Construction, $18,680,222; telephones and patents, $5,636,148; stocks and bonds, $82,614,980; real estate, $1,684,598; bills and accounts receivable, $11,460,746; cash and deposits, $3,705,265; American Bell Company, $22,110,400; total resources, $145,892,359. Liabilities.—Capital stock, $104,746,950; bonds, $15,004,500; profit and loss, $5,953,187; reserves, $2,637,935; bills and accounts payable, $1,579,577; contingent, $15,970,210; total, $145,892,359. Earnings.—Dividends, $4,890,318; rentals, $2,612,231; telephone traffic, $3,190,994; real estate, $92,059; interest, $381,005; miscellaneous, $497; total, $11,167,104. Expenses.—Operating expenses, $747,869; legal expenses, $90,693; interest and taxes, $1,134,294; telephone traffic, $1,844,197; net revenue, $7,350,051; total, $11,167,104.

BOSTON SUBURBAN.—On the Boston stock market there have recently been sharp advances in the 4 per cent preferred and common stocks of the Boston Suburban Electric companies, the former advancing 8 points to 94 and the latter to 33. These stocks have not been listed on the Boston Stock Exchange, and being somewhat closely held the market is somewhat narrow, which fact may have been a factor in the recent advance. The company has recently taken over the Waltham Gas & Electric Light Company, capitalized for $175,000 stock and $50,000 bonds, giving two shares of preferred and one-half a share of Suburban Company common stock for each share of Waltham Company stock. This plant will be used as a power station.

STORAGE BATTERY CONSOLIDATION.—The Consolidated Storage Battery Company has been incorporated with a capital of $10,000,000 by Frank H. Lord, G. T. Holmes and Oscar L. Gubelman, all of New York, under the laws of New Jersey. The capital stock is all common, par value $50 per share. The new corporation is a consolidation of the interests of the United States Battery Company, and the International Storage Battery Company, and is attracting attention in electrical circles. It is likely that details of the new company's ideas and plans will be given out next week.

WESTERN UNION'S QUARTER.—The report of the Western Union Telegraph Company for the quarter ending March 31 (partly estimated) shows a continuance of the large receipts. Net earnings increased $95,774 and the surplus $90,805. For the nine months ending March 31, there is an increase of $484,822 in net earnings and $474,880 in surplus. The total surplus on March 31 is set down as $10,348,856. The surplus for nine months amounts to $1,029,570, or over $160,000 more than for the full fiscal year ending June 30, 1901.

EMPIRE STATE TELEPHONE.—A bill has been introduced at Albany, N. Y., for the incorporation of the Empire State Telephone Company, with a capital stock of $1,000,000 and the right to increase it to $10,000,000. The bill provides giving the company a broad charter.

BRITISH WESTINGHOUSE.—Financial organs announce that the British Westinghouse Electric & Manufacturing Company has issued £500,000 4 per cent mortgage debenture stock to defray the cost of the new additions to the plant.

DIVIDENDS.—The Union Switch & Signal directors have declared the regular quarterly dividends of 2 per cent on the preferred stock and 1 per cent on the common. A dividend of 1½ per cent has been declared for the quarter on American Telephone & Telegraph. A quarterly dividend of 1 per cent has been declared by the Union Traction & Electric Company of Providence, R. I. United Traction & Electric of New Jersey directors have declared a dividend of 1 per cent, payable April 1. The directors of the Electric Storage Company have declared a quarterly dividend of 1¼ per cent on the preferred stock and a quarterly dividend of 1¼ per cent on the common stock, payable April 1. The directors of the Cumberland Telegraph & Telephone Company have declared a quarterly dividend of 1¾ per cent, payable to stockholders of record March 20. The American Stoker Company directors have declared the regular quarterly dividend of 2 per cent on the preferred stock, payable April 15. Directors of the Rochester Railway have declared the regular quarterly dividend of 1¼ per cent on the preferred stock, payable April 1. United Gas Improvement Company directors have declared the regular quarterly dividend of 2 per cent, payable April 15. The Detroit United Railway Company has declared a quarterly dividend of 1 per cent, payable April 1.

GENERAL ELECTRIC GOSSIP.—A special dispatch from Boston remarks: The General Electric Company keeps up the record of large earnings. Earnings for the 1901 year aggregated $12,000,000, or about 40 per cent upon its capitalization, and 15 per cent upon the present selling price of the stock, $300 per share. We understand that the work for the year just beginning has been fully mapped out and that it is estimated that net earnings of fully $15,000,000 are in sight for the present fiscal year. Such net earnings would equal 37½ per cent on the company's prospective capital of $40,000,000 when it returns to stockholders this spring the shares taken from them in the reduction in the capital stock in 1898. It should not be forgotten that the General Electric Company saves about $2,000,000 this year in its copper requirements alone. It bought early in the year practically a full year's supply of copper from the Amalgamated Copper Company at 11 cents per pound, and on the basis of the consumption of 3,000,000 lbs, per month there is a saving of 6 cents per pound over the bulk of the copper it purchased from the Amalgamated Company in 1901. This saving is equal to the 8 per cent dividends the General Electric is now paying to its stockholders.

Commercial Intelligence.

THE WEEK IN TRADE.—The week closed with a very favorable aspect, particularly as to weather and industrial conditions, which are reported by the mercantile agencies to have greatly improved in various sections of the country. Sections heretofore reporting favorable conditions repeat them, while less favorably situated sections, the South and Southwest, return more cheerful advices. There was less excitement but more strength in iron and steel. A specially noteworthy indication of general prosperity is the fact that agricultural implement manufacturers bought heavily of bars, the Pittsburg sales being reported at 100,000 tons, almost all, however, at old prices. New buyers must pay the advance of $2 per ton demanded. Illustrations of the strong situation in all lines are seen in the reports that bar manufacturers are sold five months ahead; the rail mills are sold ahead for the entire season; steel and wire mills have booked orders for three months' capacity and the Valley furnaces have sold three-fourths of their entire year's product. The United States Steel Corporation's vast business is shown by the official announcement that there are now on the books of the corporation uncompleted orders for various sorts of finished products amounting to $60,000,000. This, at the selling prices, represents business aggregating $300,000,000, and assuming that the corporation received no fresh orders, those now on the books will keep its plants busy for nine months to come. The demand for building material increases as spring influences manifest themselves. Coal is still in active demand and strong in price. In railway operations, the gross earnings for the month of February showed a net gain of 3.9 per cent over a year ago, notwithstanding the adverse conditions as a result of storms, freshets, etc. The Pacific roads showed a gain of 19.2 per cent; the Northwestern lines one of 16 per cent; Southern lines 2.2 per cent, while those of the Central Western and Middle States show a gain of .9 per cent. Trunk line earnings have increased 1.3 per cent. The Southwestern lines showed a loss of 2.6 per cent. The copper market was very quiet throughout the week, although the undertone was much stronger than it has been for some time. The demand from consumers is good. Quotations are as follows: Lake, 12¼ to 12½c.; electrolytic, 12⅛ to 12⅜c., and casting stock, 12 to 12¼c. According to *Bradstreet's*, the business failures for the week aggregated 224, as against 178 the week previous and 207 the same week last year.

CROCKER-WHEELER EQUIPMENT IN UNITED STATES MINT.—The month of March has brought to the above company orders for eleven more motors to be added to its already large equipment in the new Philadelphia Mint. This brings the total number furnished to 120, besides four generators aggregating 625 kilowatts. Nearly the entire installation is of Crocker-Wheeler manufacture and the plant is most interesting in the completeness of the distribution of power by electricity. In fact, the metal is electrically treated from the time it enters the building until it leaves it. The electric current refines it, the tough ingot is topped, rolled, cut and weighed all in motor driven machines, an acid bath then leaves it ready for the coining machines, which are a unique application of a small motor driving a large fly-wheel of sufficient momentum to insure a heavy pressure at the instant of stamping. The whole plant demonstrates the extent to which electric operation may be successfully carried. An elaborate illustrated article on the subject has appeared in these pages.

THE KILBOURNE & CLARK COMPANY, of Seattle, Wash., has just completed the installation of 25 Western Electric enclosed type motors with Cutler-Hammer multiple switch starting rheostats and controllers, ranging in capacity from 5 hp to 40 hp in the shipbuilding plant of the Moran Brothers Company of that city, who were recently awarded a contract for the building of one of the new first-class battleships, the disadvantage of distance from base of supplies for construction material being overcome by the citizens of Seattle, who raised by subscription $500,000 within three days as a bonus. The motor contract was secured in the face of competition and under the most rigid specifications, but the installation has been completed and motors are now in operation, giving complete satisfaction.

WAGNER-BULLOCK CONTRACTS.—Among the contracts closed through the Wagner-Bullock Electric Company's Pacific Coast agency may be mentioned: An electric light plant for Blaine, Wash.; a 75-kw Bullock single-phase generator will be installed in the lumber mill of L. W. David; Wagner transformers, switchboard, etc., are included; a 32-kw direct-current Bullock generator, direct connected to a Union Iron Works engine to be used for light and power in the United States Naval Station, Bremerton, Wash.; electric light installation to operate 3000 lights, and a few motors in the large six-story Young Building in Honolulu, H. T. There are to be two Bullock 100-kw generators and one 40-kw generator. Each generator is direct connected to a Union Iron Works engine.

NEW POWER HOUSE FOR SAN FRANCISCO.—The Market Street Railway Company has given orders to prepare the site for the erection of its new 16,000-hp electric power station near Black Point, in San Francisco. Contracts are now being filled for a 3000-hp Babcock & Wilcox boiler plant, and a Union Iron Works engine. The General Electric Company will supply two 1250-kw engine-driven generators and three 750-kw rotary transformers, and additional machinery contracts may soon be closed for this power house. After the proposed consolidation of the Market Street with three other lines by the purchasing syndicate, much more power will be required. Several cable lines will be changed into electric lines by the new owners.

THE H. W. JOHNS-MANVILLE COMPANY has recently secured several contracts for the application of its covering, among which are the Park Realty Building, Sixty-third Street and Madison Avenue, New York, moulded sectional covering. Asbestocel sectionel covering is being used by the International Silver Company, of Meriden, Conn., and the club house, at the Jamaica race track is also being fitted. Fire felt and Asbestocel coverings are being used for insulation by the Landers Frary & Clark Company, New Britain, Conn.

AMERICAN ENGINE COMPANY, of Bound Brook, N. J., reports large sales of its American-Ball duplex compound engines, including four to Snellenburg & Company, Philadelphia, one to the American Steel & Wire Company, Cleveland, and one to the United Gas Improvement Company. Among engines of this type now being installed are three, each of 400 horse-power, for the Ansonia apartments in New York City, and another of 325 horse-power for the American Steel & Wire Company.

AUTOMATIC TELEPHONES.—The Clark Automatic Telephone Switchboard Company, of Providence, R. I., has closed a contract with the Maine Insane Hospital for a 60-point Clark automatic telephone equipment.

BALL ENGINE ORDER.—The Durham Traction Company, Durham, N. C., has recently ordered a 300-hp tandem compound engine, direct connected to a General Electric generator. The Ball Engine Company, Erie, Pa., will build the engine.

ST. JOSEPH, MO., POWER PLANT.—The St. Joseph Railway, Light, Heat & Power Company will make an addition to its power plant at a total cost of $100,000

FEDERAL CHEMICAL COMPANY, of West Nashville, Tenn., is to equip a fertilizer and sulphuric acid plant with electric power.

EXPORTS OF ELECTRICAL MATERIAL.—The following are the exports of electrical materials and machinery from the port of New York for the week ended March 5: Antwerp—5 pkgs material, $198; Argentine Republic—6 pkgs material, $302; 1874 pieces conduit pipe, $1,800. British East Indies—322 pkgs machinery, $8,328; 3 pkgs material, $79. British Possessions in Africa—163 pkgs material, $10,858; 238 pkgs machinery, $7,392. Bristol—2 pkgs machinery, $620. Brazil—404 pkgs. material, $12,197; 5 pkgs. machinery, $1,437. Bilboa—4 pkgs. material, $200. Bradford—1 pkg. material, $40; 51 pkgs. wire, $2,600. British West Indies—12 pkgs. material, $225. Chili—8 pkgs. material, $118. Cardiff—83 pkgs. wire, $1,150. Central America—25 pkgs. material, $693. Cuba—1 pkg. machinery, $200; 12 pkgs. wire, $331; 16 pkgs. material, $506; 39 pkgs. wire, $203. Dutch West Indies—2 pkgs. material, $17. Dublin—1 pkg. material, $449. Egypt—15 pkgs. machinery, $1,500. Genoa—7 pkgs. material, $202. Glasgow—10 pkgs. material, $700; 34 pkgs. machinery, $2,500. Gainsborough—1 pkg. motors, $175. Hull—1 pkg. machinery, $45. Hamburg—12 pkgs. machinery, $1,870; 45 pkgs. material, $2,874. Huddersfield—10 pkgs. wire, $3,300. Leghorn—1 pkg. material, $400. Liverpool—198 pkgs. machinery, $7,556; 46 pkgs. material, $1,639; 535 pkgs. copper material, $28,440; 35 pkgs. wire, $3,683. London—109 pkgs. machinery, $3,947; 66 pkgs. material, $4,132. Mexico—613 pkgs. material, $3,411; 69 pkgs. machinery, $10,530. Naples—12 pkgs. material, $91. Nordkoping—1 pkg. material, $15. Newcastle—1 pkg. material, $250. Nuremburg—1 pkg. material, $15. Philippines—25 pkg. machinery, $1,445. Stockholm—5 pkgs. material, $90. Southport—20 pkgs. machinery, $2,870. Uruguay—7 pkgs. material, $240. Venezuela—35 pkgs. material, $739.

THE STROMBERG-CARLSON TELEPHONE MANUFACTURING COMPANY, of Chicago, has recently completed arrangements for increasing its capital stock and consequently its facilities. This company, although enjoying a wonderful growth the past five years, has not been able to keep up with the demands of the trade for apparatus, and the increase in capital stock simply means that the facilities can be increased more rapidly to take care of the business offered. There will be no change in management. To those familiar with the company's rapid growth and the immense factory it recently purchased it will be a surprise to learn that this tremendous business amounting to over $300,000 a month, has been carried on with the original capital stock of $50,000. The amount of new stock issued will exceed $2,000,000, and will depend on the earnings. The opportunities for an increase of manufacturing facilities which this increase of capital offers gives the company a very strong position in the field. Eugene H. Satterlee and Thomas W. Finucane, Rochester, N. Y., capitalists, are to take a large amount of the new stock. These gentlemen are stockholders in the independent exchange at Rochester and in extending their operations in the construction of independent exchanges will now have control also of a source of supply.

THE ELECTRIC STORAGE BATTERY COMPANY, of Philadelphia, has within the last few weeks closed the following contracts for storage batteries to be used for trolley regulation: The Altoona & Logan Valley Railway, Altoona, Pa.; Allegheny County Light Company, Pittsburg, Pa.; Pittsburg Railway, Pittsburg, Pa.; Sandusky, Monroeville, Bellevue & Norwalk Traction Company (two batteries), Sandusky, Ohio; Parkersburg & Interurban Railway, Parkersburg, W. Va.; United Electric Company, Newark, N. J.; Pueblo Traction & Lighting Company, Pueblo, Col.; Boston & Maine Railroad, Concord, N. H.; Camden Inter-State Railway (two batteries), Huntingdon, W. Va.; Seattle Electric Company, Seattle, Wash.; Seattle & Tacoma Interurban Railway (three batteries), Seattle, Wash.

THE BUFFALO FORGE COMPANY, of Buffalo, N. Y., with New York office at 41 Cortlandt Street, is not complaining for lack of business. It is supplying the American Smelting & Refining Company, at Maurer, N. J., with a heating and ventilating plant, and is also putting a small heating plant in Siegel & Cooper's store, Eighteenth Street and Sixth Avenue, and a drying plant in Abendroth & Root Manufacturing Company, at Newburg, N. Y., is to be used for drying galvanized iron pipe and sheet, as it is taken out of its acid bath. Heretofore the method for drying has been by using direct steam, whereas, through the substitution of this system, the time has been reduced one-fourth of that formerly used. Another advantage is the saving of space occupied by the drying plant.

VAST WATER-POWER PROJECT.—Final surveys have been completed in connection with a vast water-power project, which is to be carried out with a view to furnishing the city of Duluth, Minn., and vicinity, with cheap power for light, traction and manufacturing purposes. The enterprise is to be operated by the Highland Canal & Power Company, of which Mr. C. C. Cokefair is the president. The chief engineer of the company is Mr. F. A. Cokefair, his son. The water is to be brought from the Rice Lake district. A lake three miles long will be dug and the water will be carried to a hilltop 775 feet in height in the immediate vicinity of Duluth. In the first instance it is proposed to erect a plant having a capacity of 30,000 horse-power.

THE GREEN ENGINEERING COMPANY, Chicago, reports a great number of sales so far this year of its traveling link chain grates, among the orders taken being: American Tin Plate Company, 6000-hp; Union Steel Company, 6000-hp; American Steel Foundry Company, St. Louis; Crane Company, Chicago; Armour & Company, Kansas City; Armour & Company, East St. Louis; Armour & Company, Chicago; Cudahy Packing Company, South Omaha, repeating order; Danville, Ill., Street Railway & Light Company, repeating order; Ballard & Ballard Company, Louisville; Emery, Bird, Thayer Company, Kansas City; Cleveland Worsted Mills; Norwood Water Works.

JOLIET WATER POWER.—A special dispatch from Chicago of March 15 says: The first of the contracts for the completion of the water power plant of the Economy Light & Power Company of Joliet have been let. The total cost of the additional improvements will be about $200,000. Twelve water wheels of nearly 400 horsepower each will be installed. Five hundred horse-power will be used to operate the Bridgeport pumping works, and 2000 horse-power is leased to the Edison company here to be used in lighting the city. The demand for water power makes it probable dams may be constructed at two other points in Joliet for water from the drainage canal.

BROWN HOISTING MACHINERY FOR AUSTRALIA.—The Brown Hoisting Machinery Company, of Cleveland, Ohio, whose New York offices are in charge of Mr. Bert Stadelman, at 26 Cortlandt Street, is about to make shipment to the Queensland Government Railways of a 10-ton traveling crane equipment, which will be used for handling coal at the Brisbane docks. The equipment will be operated by a 125-hp Elwell-Parker motor. The contract was secured through the export commission house of Henry W. Peabody & Company, whose New York offices are in the Chesebrough Building, State Street.

ELECTRICITY BUILDING AT ST LOUIS FAIR.—The contract for the electricity building of the World's Fair was let to Wm. Goldie & Sons Company, of Chicago, who undertake the job for $399,940, a sum just $60 less than that of the estimate of the architects who planned the building. The dimensions of the building are 525x600 feet. The specifications provide that a section of the wall of the building shall be left open to admit the passage of railroad cars bearing machinery to be installed. A feature of the building will be a series of exterior galleries.

EQUIPMENT FOR EASTON, PA., PLANT.—The Consumers' Electric Light & Power Company, of Easton, Pa., has just let a contract to the Harrisburg Foundry & Machine Works, of Harrisburg, Pa., Mail & Express Building, New York, for a 450-hp engine, to be direct connected to two generators of 150 kilowatts, to be built by the Northern Electric Manufacturing Company. The contract also calls for a 150-hp Harrisburg engine, to be direct connected to two 50-kw generators each, also of Northern Electric build. The latter engine is intended to be utilized for the driving the day load.

LARGE INDUCTION MOTORS.—The Westinghouse Electric & Manufacturing Company recently closed a contract through its San Francisco agency for two 800-hp, induction motors. They will be installed in the new works which the Standard Portland Cement Company is building at Napa Junction, Calif. A motor of the same size and type was used in operating the movable sidewalk at the Paris Exposition. There are no motors at present on the Pacific Coast that approach these in large capacity.

LARGE COAL HANDLING PLANT FOR INDIA.—The Link-Belt Machinery Company, of Chicago, Ill., is reported to be figuring on an important contract for the building of a large coal handling plant, etc., at the Calcutta docks, British India. Two of the company's engineering experts are now in India in regard to the matter. It is reported that the execution of the contract will entail the construction of warehouses, etc., which will mean the employment of over 2000 tons of structural steel.

BULLOCK APPARATUS FOR BRITISH NAVAL BARRACKS.—The new British naval barracks at Portsmouth, it is reported, are to be equipped with electric lighting machinery, manufactured by the Bullock Electric Manufacturing Company, of Cincinnati, Ohio. The contract for the complete electric lighting and other electrical work was awarded to Bergtheil & Young, of Camomile Street, London, E. C., which concern represents the British interests of the Bullock Company.

THE C. W. HUNT COMPANY, of West New Brighton, Staten Island, New York, has recently received an order from the United Railways & Electric Company, Baltimore, Md., for a set of electric hoisting machinery. This is a repeat order.

NEW FACTORY BUILDING.—The Johnson Electric Service Company, Milwaukee, Wis., expects to build a new factory building in the near future. The present quarters are already too small.

General News.

THE TELEPHONE.

SAN FRANCISCO, CALIF.—The Lewiston & Grass Range Telephone Company will construct a telephone line from Lewiston, Idaho, to Grass Range. The company was incorporated recently by James H. Charters, A. W. Warr and E. Brassey, with a capital stock of $10,000.

SAN FRANCISCO, CALIF.—The West Gallatin Telephone Company, which was recently organized by E. C. Kinney, J. M. Robinson, W. C. Newton and E. B. Martin, will construct a telephone line from Bozeman, Mont., to West Gallatin. The company's capitalization is $10,000.

DENVER, COLO.—The new Telluride exchange of the Colorado Telephone Company has reached the 200-mark, and the list is growing every day.

DENVER, COLO.—Three additional telephone wires are now being strung from Denver northward. They will run parallel as far as Louisville Junction. One will then be run to Boulder, one to Lafayette and one to Longmont.

COLORADO SPRINGS, COLO.—Improvements which the Colorado Telephone Company has authorized in Colorado Springs will cost about $50,000. Manager Morris has ordered the necessary material and work will begin at once. The underground lines of the city are to be extended and aerial cables will be strung over a large portion of the city. A new switchboard will be added to the local exchange and two additional ones for the toll service. Improvements are to be made all over the State by the company and a number of towns not in communication with Colorado Springs now will be added to the service.

DENVER, COLO.—A large portion of the $1,000,000 recently appropriated by the Colorado Telephone Company for improvements is being spent in the Glenwood district. This exchange has now 96 telephones connected and the exchange will probably have to be enlarged to accommodate 200 more during the year. There are 70 miles of circuit outside of the town limits connected with the exchange, showing that the farmers are beginning to appreciate the conveniences of the instrument. The line to Sunshine has been completed, as well as that to Spring Gulch. One improvement that will open up a new district is the line which is to be built through the Grand Canyon, affording connection with the Eagle River valley. At Rifle an exchange with 24 subscribers is being put in. There will be four circuits leading out from Rifle. One up Rifle Creek, one leading to Beaver Creek, one to Antlers and one to Parachute. These are all under course of construction.

HAVANA, CUBA.—Governor General Wood, of Cuba, has issued an order making liable to a fine of not less than $100 nor more than $500 any person, company or corporation installing a telegraph or telephone line or other public or private enterprise without proper authorization of law. The order places such person or company liable to additional fine of $25 for each day the enterprise is continued in operation after due notice for its discontinuance has been served.

CARROLLTON, GA.—The local telephone exchange of this city operated separately from the exchange of the long distance office, managed by the Gainesboro Telephone Company, is considering with the Gainesboro Telephone Company a proposition to consolidate their exchanges in this city.

BLACKFOOT, IDAHO.—The Rocky Mountain Bell Telephone Company will extend its line from Blackfoot to Mackay, Challis, Bayhorse, Clayton and Custer, thence over the Jordan Creek trail to the waters of the Middle Fork of Salmon River, where it is to connect with the line coming in from Boise, and then extend to Thunder Mountain and Roosevelt.

ROCKFORD, ILL.—The Ogle County Telephone Company is putting in an exchange at Forreston.

CARBONDALE, ILL.—Owing to the taking in by the telephone trust of the lines of Southern Illinois, a meeting was held recently at Benton at which a complete reorganization was effected, to go into effect April 1. The officers of the association are as follows: President, F. H. Stamper, of Benton; secretary, F. W. Willard, of Anna.

HENRY, ILL.—A franchise was granted by the Board of Supervisors of Bureau County to the Milo & Bradford Telephone Company, for the construction of a telephone line on the public highways between the two towns, or so much of the route as lies in Bureau County. The Henry Telephone Company was also granted a right of way on Bureau County highways for the extension of its service to such points in that county as is desired.

OAKLANDON, IND.—The Stansbury Mutual Telephone Company, capital $1,000, has been incorporated by H. C. Fred, O. D. Kleppfer and George W. Apple.

INDIANAPOLIS, IND.—The Centerville Co-operative Telephone Company has incorporated with a capital stock of $5,000, and Hardin H. Pielle, Thomas C. Dunbar, Andrew Kramer, Caleb B. Jackson, Jr., and George McConaba as directors.

FT. WAYNE, IND.—The Electrical Investment Company, of this city, has let the contract for the underground work for the Independent telephone plant at South Bend to the J. F. Butterfield Company, of Chicago, at $19,500, this being the lowest of six bids. The contract for the equipments will be let soon.

PORTLAND, IND.—The City Council has granted a franchise to the Home Telephone Company, an incorporation recently organized and composed entirely of local business and professional men. The company proposes to install an exchange, also toll lines and promises to make the service cost about one-half what it does now.

NEW CASTLE, IND.—Henry County is one of the best telephone counties in Indiana. Here are located over 3000 of the 56,000 telephones in the State. In this city there are about 300 telephones in use, with several hundred contracted for and to be put in use as soon as the new company gets started. The Cadiz company connects with over 1600 telephones and the rest are divided up among the other towns and parts of the county.

INDIANAPOLIS, IND.—In a recent interview President Sherin, of the New Telephone Company, stated that business all over the State was on the jump, and that the company had difficulty in keeping up with the demand for service. "Everybody is using the telephone," he said. "The instrument is being used for every purpose now; little tots three and four years old lisp over the telephone; invitations are given, church matters attended to, orders are given for household necessities, and people visit over the telephone."

FRANKLIN, IND.—There is much activity in Johnson County in the telephone business. Independent companies have been organized in the last month at Whiteland, Greenwood and Morgantown, and they are building lines into the country that the farmers may have the service. The organization of a company at Trafalgar is talked of. Lines from Franklin now reach almost every hamlet in the county, and the fever is spreading among the farmers. Nearly all the lines are operated by home people. There are 1000 telephones in the county, and the number is increasing as rapidly as the companies can fill the orders.

DES MOINES, IA.—The Tri-City Telephone Company has increased its capital to $135,000.

GRINNELL, IA.—The Interior Telephone Company, capital, $35,000, has been incorporated by J. P. Lyman and others.

PERRY, IA.—The Hawkeye Telephone Company, of Perry, has bought the local exchange of the Indianola Mutual Telephone Company, and will make improvements to it and other parts of the system.

ELDORA, IA.—The Eldora Mutual Telephone Company has just been organized here with a capital stock of $10,000. Its principal place of business will be at Eldora and it will conduct a telephone business in Hardin and adjoining counties. The officers of the company are L. J. Spurgin, president; A. S. Howell, vice-president; Herbert A. Huff, secretary; Ellis D. Robb, treasurer, and J. D. Newcomer, Ed. R. Davis and Thomas Larson, directors. The company has applied for a franchise which will be voted upon at the city election, Monday, March 31, 1902. The new company has over 100 telephones pledged and has made arrangements to connect with over 200 farmers' telephones in the county.

PADUCAH, KY.—Mayor D. A. Yeiser sold a telephone franchise for an independent system, and it was bought by J. L. Dunne, of Wilkesbarre.

LOUISVILLE, KY.—A special dispatch states that a war of rates has been begun between the Cumberland and Home telephone companies. The Home Company is a new independent company which has had a fine plant built by a construction company in Cleveland, and will begin operating next month. It claims to have secured 5,000 subscribers. The Cumberland is the Bell Company and is under vigorous management and has about 8,000 subscribers. It is preparing to cut prices. Telephone rates will be low in Louisville from now on.

LAKE PROVIDENCE, LA.—The Cumberland Telephone Company will build a telephone line from Lake Providence to Floyd, La., and another from Lake Providence to Tallulah, La.

MONROE, LA.—A fight is on between the Home and Cumberland telephone companies. The city has already revoked the franchise of the Great Southern Telephone Company, which was purchased by the Cumberland, on the ground of non-compliance with its provisions. Legal proceedings may ensue.

MONROE, LA.—The Monroe Telephone Company has held a meeting to consider a proposition to sell its plant to the Cumberland Telephone Company, and a board of liquidators was appointed. It is further said that A. A. Forsythe has endeavored to form a company to purchase the plant and keep the Cumberland company from securing the exchange.

DETROIT, MICH.—The Common Council has granted the Co-operative Telephone Company, organized in opposition to the Bell Company, a franchise to do business, establishing the maximum rate at $24 for residence and $48 for business telephones. The ordinance contains a provision that the company must sell its plant to the city when the city obtains the right to operate a municipal telephone exchange.

DULUTH, MINN.—The exchange of the Zenith Telephone Company was destroyed by fire on March 7. The damage was $20,000 and the company carried $17,000 insurance.

MINNEAPOLIS, MINN.—The Twin City Telephone Company, St. Paul and Minneapolis, has met the Bell rate to Superior and Duluth, and its rates will now be 40 cents for the first three minutes and 10 cents for each additional minute. Night rates, 25 cents for the first three minutes and 5 cents for each additional minute. The Bell Company reduced its rates on March 1.

CLEVELAND, MISS.—The Bolivar Telephone Company has organized with a capital stock of $10,000. Fred Clark is president.

JEFFERSON CITY, MO.—The Lewis County Telephone Company has filed a statement of increase of capital stock from $1,800 to $7,500.

BRAYMER, MO.—The Regal Telephone Company, of Braymer, with a capital stock of $1,375, has been incorporated. The incorporators are H. N. Bunche, C. M. Burnett, Daniel Braymer and others.

NEVADA, MO.—Theo. Cary, president of the Macon Telephone Company, has purchased the Nevada exchange, and is organizing a strong company, which will include a number of the leading citizens as stockholders; $10,000 will be expended in the extension of the system, which is now confined to Nevada, so that it will cover Vernon County.

ST. JOSEPH, MO.—The Missouri River Telephone Association, comprising owners of independent lines, met here recently, executed agreements and tariffs for the present year, and agreed on joint construction of considerable work. Thirty members were present. Officers were elected as follows: H. E. Ralston, Maitland, president; G. A. Haynie, Savannah, vice-president; L. N. Frye, Grant City, secretary and treasurer.

JACKSON, MONT.—Bids are being received by the trustees of the Dillon & Basin Telephone Company, at their office at Jackson, for the construction of a telephone line from Wisdom, Mont., to Bannack, Mont., 50 miles.

OMAHA, NEB.—The Douglas County Telephone Company has filed articles of incorporation. The capital stock is $10,000, and $1,000 must be paid in before the company begins business. It is proposed to construct and operate a complete suburban telephone system, covering the greater part of the rural precincts of the county. The incorporators are Mons Johnson, George Cowles, A. E. Dodson, L. B. Byars, S. H. Howard, J. G. Seefus and I. N. Esmay.

YORK, NEB.—Representatives of the York County independent telephone companies met for the purpose of either consolidating into one large company or to entertain the proposition from the Plattsmouth Telephone Company. A majority of the delegates favored consolidating all the independent companies of York County, and a motion was passed to this effect. The meeting then decided to organize a company known as the York Independent Telephone Company, with headquarters at York, and to be entirely independent of the Plattsmouth company, except that the Plattsmouth company will run in the York office its copper toll line, which now reaches 20 counties in Southeastern Nebraska.

ELIZABETH, N. J.—The Interstate Telephone Company has paid into the hands of John W. Whalen the price of 293 shares of the old Elizabeth Mutual Telephone Company, being the full amount of shares, less seven, at 30 cents premium on the dollar. It is announced that an extra dividend of 25 per cent will be declared to the stockholders, and the new company will assume control of the Elizabeth Mutual Company.

GENESEO, N. Y.—A local telephone company has been organized in Geneseo and expects to start business with 300 subscribers.

ALBANY, N. Y.—The Eastern New York Telephone & Telegraph Company, capital $50,000, has been incorporated. Directors: Watson M. Holmes, Ralph D. Smith, and Levi E. Worden, Hoosick Falls.

CONCORD, N. C.—The town has amended the Bell Telephone franchise, permitting the company to put in a long distance service but not a local exchange. The Bell has been trying to enter the town for some time.

MAYVILLE, N. D.—The Burgesses of Anetz, it is said, will soon extend their telephone line to Hatton and take in farmers between the two towns.

PEMBINA, N. D.—The long-distance telephone company is preparing to extend its lines from Crookston north to St. Vincent. Grand Forks will also be connected with Drayton and Devil's Lake.

ASHLAND, OHIO.—The Star Telephone Company will build new lines from Ashland to Redhaw and a small exchange will be installed in the latter place.

MARYSVILLE, OHIO.—The Marysville Telephone Company is preparing to establish a farmers' community system centering in the village of York.

HAMILTON, OHIO.—The Hamilton Home Telephone Company has leased a portion of the Frechtling building for an exchange. Work will start at once on the system.

ALLIANCE, OHIO.—The Eastern Ohio Telephone Company is preparing to build a line to Minerva to connect with the Stark County Telephone Company's line to that place.

DAMASCUS, OHIO.—The Damascus Telephone Company has been incorporated with $10,000 capital stock to operate telephone lines in Columbiana, Mahoning, Stark and Portage counties.

SANDUSKY, OHIO.—Sidney Kilbourne, secretary of the Sandusky Telephone Company has been succeeded by John C. Hauser. J. A. Giedeman succeeds the latter as treasurer of the company.

NORTH GEORGETOWN, OHIO.—The North Georgetown Telephone Company has been incorporated, with $5,000 capital stock, by W. J. Kelly, J. M. Earnst, E. G. Saffell, E. E. Summers, Ed. Reichenboch, and others.

PERRY, OHIO.—President DeVoe, of the Madison Telephone Company, is preparing plans to thoroughly rebuild the system in Perry. The company has installed a new switchboard at Madison and improvements will be made in Geneva.

FINDLAY, OHIO.—It is stated that eastern people are desirous of securing the 60 per cent interest held in the Findlay Home Telephone Company by the Federal Telephone Company of Cleveland, whose affairs are now in charge of a bankers' committee.

DEFIANCE, OHIO.—The Central Union Telephone Company will overhaul its local system. The present party lines will be replaced with selective signal instruments, full copper circuits, and the Blake transmitters will be replaced with long distance instruments.

PROSPECT, OHIO.—The Prospect Telephone Company, of Prospect, has incorporated, with $30,000 capital stock. W. M. Heseltine is at the head of the project. The company will operate systems in Prospect and Radnor and build lines connecting Delaware, Richwood and Marion.

TOLEDO, OHIO.—The Empire Construction Company of Toledo has secured a franchise for an independent system in Los Angeles, Cal. The franchise is for 50 years and it is said that 1,500 subscribers have already been secured in the face of strenuous opposition from the Bell Company.

NAPOLEON, OHIO.—The village Council has practically refused to grant the application of the Central Union Telephone Company for a franchise because it is claimed the erection of additional poles and wires would endanger buildings in case of fire. The company has applied to the Probate Court and will endeavor to force a franchise.

GLOUSTER, OHIO.—John J. Gordon and Walter Ross, president and general manager, respectively, of the Union Telephone Company, operating in Nelsonville, Murray City and Glouster, have sold their interests in the company to David Edwards and Dr. B. W. Pickering. New officers were elected as follows: G. W. Rose, president; D. Edwards, secretary-treasurer; A. B. Allen, general manager.

BELLEFONTAINE, OHIO.—The United Telephone Company, of this city, recently incorporated with a capital stock of $25,000, which controls nearly all the independent lines in this portion of the State, has announced the adoption of the co-operative principle in its business. All employes whose monthly salaries are $50 or less are to be conidered to the extent of that salary, so far as dividends are concerned, the same as stockholders.

OTTAWA, OHIO.—A committee of citizens have visited Chicago and inspected the plant and plans of the Columbia Telephone Company which proposes to locate here, and have reported favorably on the proposition. The preferred stock of the proposed new company has all been subscribed and it is announced that the factory is certain to be located in Ottawa. Proposals for a site have been asked for and a permanent organization will be effected within a few days.

CLEVELAND, OHIO.—Stockholders of the Federal Telephone Company met at Trenton, N. J., a few days ago and by a vote of 75 per cent of the stock indorsed the collateral trust plan, as recently outlined. Also a plan to sell the entire assets of the company in an entirety if a sufficiently good offer is made. Now that the stockholders have taken this action, vigorous efforts will be made at once to sell the $6,500,000 worth of bonds to be issued under the collateral trust plan. It is the intention of the bankers' committee to proceed if possible under this plan, rather than to sell the assets of the company. The members of the committee have great faith in the plan, and in the future of the Federal properties, and they do not wish to see the control of the company pass out of Cleveland.

CLEVELAND, OHIO.—The bankers' committee in charge of the Everett-Moore affairs has closed a deal with President Lanman and leading Columbus stockholders of the Columbus Citizens Telephone Company, to sell enough of the stock of the company held by the Federal Telephone Company to give the Columbus people the controlling interest in this exchange. In return the Columbus people agree to extend the business by putting in an additional switchboard at a cost of $300,000, and to give the syndicate an option upon the shares they buy, so that the Federal company, if offered an opportunity to dispose of the telephone interests in their entirety, may be able to sell. The Columbus company has 5500 telephones in operation and orders for 1000 more. It is claimed that by the time another switchboard is installed, there will be orders for 3000 or 4000 more telephones. Under these conditions the Columbus stockholders were exceedingly anxious to secure control in order that the improvements might be made at once. Chairman Newcomb, of the bankers' committee, states that similar arrangements are being made with stockholders of the Jackson, Mich., Telephone Company, as immediate extensions for this plant are desirable. This deal will be closed up at once. It is the intention of the committee to sell the uncompleted plants of the People's Telephone Company, Detroit, and the Dayton Home Telephone Company, Dayton, as it would require $1,500,000 to complete the Detroit plant and $600,000 to place the Dayton plant in operation. Negotiations for the sale of these properties will probably be closed in the near future.

CARWILE, OKLA.—The Farmers' and Business Men's Telephone Company has been incorporated by J. H. Madaris, O. A. Brewer, Guy T. Johnson, J. B. Van Dyne and C. M. Brewer. Capital, $10,000.

PORTLAND, ORE.—The Pacific States Telephone & Telegraph Company has been granted a 25 years' franchise by the city authorities of Portland. It operates the same system that was formerly known as the Sunset Telephone & Telegraph Company.

PORTLAND, ORE.—It is said that a strong combination of telephone systems is being formed in the Pacific Northwest with lines radiating from Portland. As far as the Pacific Northwest is concerned the combination as at present formed includes telephone companies in Portland, Seattle, The Dalles, Forest Grove and McMinnville. Lines, it is announced, will be run into every town in Oregon and Washington, and probaby parts of Idaho and Montana. The company controlling most of the companies named is the Northwestern Telephone Company, of Youngstown and Warren, Ohio.

NEWTOWN, PA.—The Standard Telephone Company has been granted a franchise covering a number of streets in Langhorne and an extension of 90 days in its franchise for Sellersville, which provided that the system there should be completed by March 11.

MONTREAL, QUE.—The management of the Windsor Hotel in Montreal has decided to install four hundred telephones in the rooms of the hotel, which, in addition to being connected with the hotel office, will be connected with the city and long distance telephone lines.

COLUMBIA, S. C.—The South Carolina Telephone Company is preparing to rebuild the lines in the Pee Dee section and make improvements in all exchanges. A large part of the material has been ordered.

HUDSON, S. D.—A franchise has been granted to the Hudson Telephone Company, which is composed of local business men.

MANCHESTER, TENN.—The Cumberland Telephone Company has purchased the Dixie line between this place and Tracy City, including the entire system in Warren, Grundy and Coffee counties.

DALLAS, TEX.—The National Telegraph Company, of Dallas, with a capital stock of $10,000, has been incorporated by G. C. Felton, J. L. Newton and J. J. Stephens.

TEXARKANA, TEX.—The Frerman Telephone Company, operating about 500 miles of lines and touching 36 towns in Arkansas, was on March 3 absorbed by the A. I. Kijer Telephone Company.

HOUSTON, TEX.—The telephone exchange of the Houston & Texas Central Railroad has been equipped with a new switchboard of the latest pattern and new telephones have been installed in the principal offices, some twenty in all.

SALT LAKE CITY, UTAH.—The City Council has granted a franchise to the Utah Home Telephone Company. The new company will have $500,000 capital, and will be backed by Eastern capital.

MORGANTOWN, W. VA.—The Merchants' Protective Association, composed of prominent business men, has ordered its secretary to notify the Bell Telephone Company to remove all telephones in the offices of merchants. The action was taken because of the refusal of the company to make the concessions asked for by the association.

TOMAH, WIS.—Tomah Electric & Telephone Company, capital, $25,000, has been incorporated by Charles W. Croty, William B. Naylor, Jr., Edward E. Schwerer.

MILWAUKEE, WIS.—Another attempt is being made to secure the passage of the ordinance granting a franchise to the Great Western Telephone Company to do business in Milwaukee.

CHEYENNE, WYO.—The Rocky Mountain Bell Telephone Company is preparing to erect its line across Wyoming from south to north, as was the announced intention last fall. The gap to be bridged extends from Lander to Basin City.

ELECTRIC LIGHT AND POWER.

SELMA, ALA.—The Selma Light & Power Company, of this city, has been purchased from its owners in this city by a party of Virginia and Pennsylvania capitalists. The company will be reorganized and the officers for the coming year will be elected.

SAN FRANCISCO, CALIF.—The Bay Counties Power Company, which is now operating the longest electric power transmission in the world—from the Colgate Station to Stockton, Calif., 220 miles—recently completed the installing of the last 2000-kw generator. It is a Stanley machine, direct connected to a Risdon Iron Works impulse wheel.

SAN FRANCISCO, CALIF.—It is reported that the Quartette Mining Company will install several current wheels in the Colorado River near Quartette, Ariz. The wheels to be experimented with were invented by J. A. Walker, who expects them to drive the company's electric power plant and transmit electricity 18 miles to operate its mines and mills.

SAN FRANCISCO, CALIF.—The Mount Whitney Power Company, which has a 3,000-horse-power electric transmission plant on the middle fork of the Kaweah River, 27 miles from Visalia, will extend its power lines to Dinuba, Tulare County. Electric pumping for irrigation purposes is carried on extensively in the districts traversed by the company's lines.

SAN FRANCISCO, CALIF.—Mr. Frank M. Stone, of this city, and Colonel W. H. Dow, representing a New York syndicate, it is stated, have formed a company to utilize the waters of the Snake River at Shoshone Falls. A plant of 20,000 hp capacity will be installed, and the electric energy will be utilized largely in irrigation work and the operation of electric street railways. There is a drop of 215 ft. at these falls.

SALINAS, CALIF.—The Salinas Water, Light & Power Company has taken over the electric and water works plants of the Salinas Light & Water Company, located in Salinas. The new company, which was incorporated by residents of Los Angeles, has filed a deed of trust to the Title Insurance & Trust Company, of that city, for $150,000. The officers of the Water, Light & Power Company are: O. Z. Hubbell, president; F. J. Whiffen, treasurer; R. C. P. Smith, secretary; J. M. Gardiner, vice-president and manager.

SAN FRANCISCO, CALIF.—The electric transmission lines taking power from the Standard Electric Company's generating station at Electra, Alpine County, Calif., will be extended from Campbells to Los Gatos and Gilroy. It is possible that another extension will be constructed to Salinas, Hollister, Monterey and Santa Cruz. Milpitas and Berryessa have been connected with the main transmission lines by a branch from a point near Warm Springs. The Electric Improvement Company, of San Jose, attends to the distribution of a large part of the Standard Electric Company's power in these localities. The Consolidated Light and Power Company also distributes a part of the electric power in the counties south of San Francisco.

ATLANTA, GA.—The Atlanta Water & Electric Company, capital $500,000, has applied for a charter for electric and water power. S. Morgan Smith is interested.

NEW ORLEANS, LA.—The Council has adopted a municipal lighting ordinance and abandoned the ten-year plan of acquiring a plant. The decision of the Supreme Court is said to be accountable for this action. Legal entanglements, it seems, are involved in the case.

EVART, MICH.—An election will be held in the near future to decide on the proposition of expending $4,500 in enlarging the local lighting plant. The plant has been profitable and the proposition is being favorably received.

MINNEAPOLIS, MINN.—The St. Paul Gas & Electric Light Company has recently ordered two 650-hp Westinghouse gas engines, which are to be installed in the company's St. Paul power-house.

NEW ULM, MINN.—The city will advertise for the sale of the bonds voted for the new electric light plant, and also for bids for the erection of the necessary buildings. The plant will cost in the neighborhood of $50,000.

BILOXI, MISS.—The Biloxi Electric Light Company has decided to enlarge its plant and add new machinery.

VALLEY PARK, MO.—A syndicate of Pittsburg capitalists has purchased Valley Park, Mo., and will establish a model town, with electric lighting, etc., in charge of D. J. Murnane, Robert Naysmith and W. W. Darley, of Pittsburg.

HELENA, MONT.—After a number of delays Butte electrical power from the Missouri River dam near here is now being transmitted to Great Copper Camp, Where Never Sweat, St. Lawrence, Anaconda and other mines. The Amalgamated Company is lighting and hoisting at plants furnished with motive power at a rate of from 45 to 60 per cent less than that formerly developed by steam. For the purpose of transmitting electricity to Butte a double-pole line was constructed which carries six wires. These wires contain more than 1,000,000 lbs. of copper. Eight thousand horse-power is thus transmitted for a distance of 65 miles. The pole line crosses the main range of the Rocky Mountains. Extensive experiments were made which proved beyond doubt the feasibility of the scheme. The present dam and the Butte and Helena pole lines cost about $2,000,000, and plans are being prepared for the construction of a second dam below the present one to meet the demand for additional power. The loss of power in transmission between the dam and Butte is less than 7 per cent.

JERSEY CITY, N. J.—The Western Lighting Company has been incorporated here. Capital, $500,000. Incorporators: W. M. Greene, Nelson R. Vanderhoof, Charles N. King.

JERSEY CITY, N. J.—The Cincinnati, Newport & Covington Light & Traction Company has been incorporated here. Capital, $10,000,000. Incorporators: E. T. McLaughlin, Jersey City; Henry W. Clark, James C. Converse, New York City.

SMITHFIELD, N. C.—The Town Council is considering the question of submitting a bond issue to the people for electric lights.

WASHINGTON, N. C.—The Washington Light & Water Company has been incorporated at Washington, with a capital of $20,000, with the privilege of increasing to $200,000. Geo. T. Leach, of Washington, N. C., and Pennsylvania capitalists are interested.

GOLD HILL, N. C.—The Whitney Reduction Company is rapidly pushing the work of harnessing the narrows of the Yadkin River. The company will have a private telephone line and will build a railway about seven miles long from the Narrows to New London, N. C.

HALIFAX, N. S.—The directors of the Halifax Electric Tramway Company propose to issue 1,000 shares of new common stock to pay for improvements in the company's lighting plant in order to bring that portion of its business to an up-to-date condition, as the company will give the city of Halifax a new system of street lighting, for which the company has a five years' contract.

NEW YORK, N. Y.—It is stated that a syndicate of American capitalists has been formed for the purpose of manufacturing electricity in the Philippines on a large scale. If conditions warrant it millions of dollars will be invested in electric light and power plants, traction lines, etc., in the new Eastern possession of the United States. Preliminary steps have been taken in this direction by the organization of the Manila Electric Company with a capital stock of $125,000. The capital will be largely increased, however, if the projectors see their way clear to carry out their plans.

CANTON, OHIO.—After a long controversy, the council has granted a franchise to the Central Heat & Power Company. The ordinance provides that the maximum rates shall be not more than 13 cents per kilowatt hour. The grant is for 25 years.

DAYTON, OHIO.—E. J. Barney and others have completed plans for the erection of a large market house, office building and arcade. Contracts for structural work have been placed with the Brown-Ketcham Company, of Indianapolis. The power plant includes electric lighting and machinery for six electric elevators.

COLUMBUS, OHIO.—The circuit court has sustained the lower court in dissolving the temporary injunction restraining the city of Columbus from constructing and maintaining its own lighting plant. J. P. Lind brought the action to enjoin the city, claiming that notice had not been properly published, and the voters had not been given the proper authority to vote on the proposition.

COLUMBUS, OHIO.—A meeting of the stockholders of the Columbus Electric Company has been called for March 25 to ratify or reject a contract entered into between the directors of the company named and the Columbus Edison Electric Light Company, favoring the consolidation of the properties. If the measure goes through the company will be known as the Columbus Edison Company. The capital stock will be $1,000,000, of which $550,000 will be preferred stock.

ABBEVILLE, S. C.—W. M. Thompson, of Anderson, S. C., has purchased the stock of the Electric Light & Power Company of Abbeville, and it is said that he will rebuild the power plant and machinery recently destroyed by fire.

CENTERVILLE, TENN.—The new electric light plant was put in operation recently and for the first time in the history of the town electric lights were used.

NASHVILLE, TENN.—A charter has been granted to the Holston Water & Electric Power Company in Sullivan County. James Gamon, E. K. Crymbie, W. T. Neely and others are interested.

NASHVILLE, TENN.—A 600-hp engine has been received for the municipal lighting plant and when the new plant is put into operation Nashville, it is said, will be one of the best lighted cities in the United States.

NASHVILLE, TENN.—Application has been made to the Council for a franchise for the Great Falls Power Company. The company was given a franchise a year ago, but not having completed its plant a new franchise had to be sought. The company is to have power for distribution by January, 1905.

LOGAN, UTAH.—At the meeting of the City Council of Logan the establishment of a municipal lighting plan was discussed. It was decided to send a committee to American Forks to investigate the workings of the plant there. A piece of land has been purchased for the site; about 25 miles below the town, and if the plant is constructed power and light will be sold to the surrounding towns. Later—The City Council of Logan has received a report on the proposed municipal electric lighting plant. The estimated cost of the new system was $42,000.

EVANSVILLE, WIS.—A municipal light and water plant is to be operated here and $51,000 in bonds are to be issued for its purchase.

MILWAUKEE, WIS.—The Milwaukee Harvester Company has awarded a contract for a Westinghouse alternating 600-kw 440-volt two-phase generator to be direct connected to a Corliss engine.

NEW RICHMOND, WIS.—A $100,000 water power deal has been closed whereby Stillwater capitalists will take over all the stock in the company now held by Eastern parties. The Stillwater parties will also invest much money in the enterprise. This probably means the development of another water power on the Apple River, in addition to the power now developed and being used at Somerset. Almost every manufacturing plant here and the street lighting and the pumping at the city water works are operated by electric power transmitted from the company's present plant at Somerset, 8 miles West of this city.

THE ELECTRIC RAILWAY.

BIRMINGHAM, ALA.—The Board of Aldermen has granted some additional franchise rights to the Birmingham Railway, Light & Power Company. J. R. Adams and associates were also granted a franchise permitting them to enter the city with an electric railway.

DECATUR, ALA.—J. T. Crass, who owns several electric railways in Tennessee and Kentucky, has visited Decatur to investigate prospects for a new line. Mr. Crass desired either to obtain the franchise of the Decatur Street Railway Company, granted by the Decatur Land Company as an exclusive franchise before the incorporation of New Decatur, or to obtain a new franchise.

DENVER, COLO.—The Whitney-Ryan-Widener-Elkins syndicate has practically completed the deal to secure the Denver City Tramway. The price paid is said to be $8,500,000 which covers the Denver City Tramway Company, the Metropolitan Street Railway Company, the West End Railroad Company, the Denver City Traction Company and the Colfax Electric Company. The company is stocked for $5,000,000 and has $5,875,000 in bonds outstanding.

LOUISVILLE, KY.—Promoters have sought right of way for an electric railway to run from Louisville to Mt. Washington. The road proposed is 22 miles long and $400,000 would be required for its construction. Among local capitalists interested are Peyton M. Clark, Jas. C. Wright and possibly Ohio capital.

GLASGOW, KY.—The Glasgow, Burkeville & Cumberland Valley Traction Company has effected permanent organization by electing officers as follows: Dr. J. S. Leech, president; C. W. Alexander, treasurer, and W. P. Dickerson, secretary. The projected lines will be about 40 miles in length. About two-thirds of the right of way has been secured.

MONROE, MICH.—The Detroit River & Lake Erie Terminal Company has been incorporated by George Spalding, George M. Landen, Chas. E. N. Cales, D. B. Cunningham and others who are connected with the Strang Construction Company which is building the Detroit & Toledo Shore Line. While the parties decline to explain their intentions it is believed they propose to build a line from the present terminus of the Shore Line at Trenton into the city of Detroit with a view to disposing of it to the purchaser of the Shore Line.

MINNEAPOLIS, MINN.—The Electric Storage Company of Philadelphia is busy with the installation of a 1500-horse-power storage battery for the Twin City Rapid Transit Company at the power-house in this city. A similar battery is being installed in St. Paul.

MINNEAPOLIS, MINN.—A very unusual fall in the Mississippi River so reduced the capacity of the Twin City Rapid Transit Company's power plant at St. Anthony Falls, Minneapolis, that it has been found necessary to reduce the number of cars in service in both St. Paul and Minneapolis. For this reason, and also because of the constantly increasing number of passengers, the railway company finds it necessary to enlarge its power plants.

BILOXI, MISS.—It is reported that parties who were considering the matter of an electric railway and electric light plant will renew their application before the Town Council. A road is contemplated to extend to Gulfport. Another franchise of similar nature is yet before the Council.

ST. LOUIS, MO.—A charter has been granted to the St. Louis Belt & Terminal Railway Company, with a capital of $3,000,000, to build a belt line round the city and connect with and furnish terminal facilities for the Missouri Pacific and the St. Louis & San Francisco. The length of the line will be 21 miles.

WILMINGTON, N. C.—It has been decided not to substitute electric power on the Wilmington Seacoast Railway, at least not for twelve months. This decision was made in view of the length of time required for getting the necessary equipment and by other delays.

CHARLOTTE, N. C.—It is learned that the Four C's Electric Company of Charlotte has planned an extension of its electric railway to Biddleville within two years; also a local extension in the city.

BALLSTON, N. Y.—The Schenectady Railroad Company has decided to build a branch from Schenectady to this village, a distance of 15 miles.

PENN YAN, N. Y.—The Penn Yan & Lake Keuka Electric Railway Company has been incorporated with a capital of $120,000.

JEFFERSON, OHIO.—The village of Jefferson has granted a franchise to the Pennsylvania & Ohio Railway for its line from Ashtabula to Jefferson.

EAST LIVERPOOL, OHIO.—The East Liverpool Street Railway between this place and Wellsville was tied up because of recent high water in the Ohio River.

TROY, OHIO.—After long delays the Council has granted a franchise enabling the Dayton & Troy Traction Company to build to the center of the town. The company agreed to pay one-quarter of the cost of bridges over canal and river.

HAMILTON, OHIO.—It is announced here that the proposed Hamilton, Eaton & Richmond Electric Railway will be constructed this spring. The contract for building the line has been awarded to the Falk Construction Company, Milwaukee.

TOLEDO, OHIO.—It is stated that the Toledo Railway & Terminal Company, which is building a thirty mile steam belt line around the city, proposes to operate electrically driven cars for passenger service, in addition to the steam freight business.

CLEVELAND, OHIO.—The Cleveland Electric Railway Company is planning to extend its Wade Park Avenue line to the Windemere car barns as soon as the financial situation is cleared up. The extension would open up fine suburban residence property.

CINCINNATI, OHIO.—Indications are that arrangements will soon be completed between the interurban roads building into Cincinnati and the Cincinnati Traction Company whereby the former will enter the center of the city over the tracks of the latter.

COLUMBUS GROVE, OHIO.—The Columbus Grove Council will receive proposals for the operation of an electric railway over a recently established route through town. A company which will build from Findlay to Ft. Wayne, Ind., wants the franchise.

FINDLAY, OHIO.—It is stated that the promoters of the Findlay & Southern Railway Company have finally completed arrangements for the sale of the bonds. Options have been secured on a right of way from Findlay to Columbus by way of Mt. Blanchard and Forest.

EAST LIVERPOOL, OHIO.—Local people are interested in a project for an electric railway from East Liverpool to Chester, Hooks town and Conway, W. Va. It is the intention to operate steam trains at night, as there are rich undeveloped coal fields on the proposed route.

MADISONVILLE, OHIO.—The Madisonville Council has granted a franchise to the Cincinnati & Columbus Midland Traction Company. The company has secured right of way between Columbus and Blanchester. The road will form the most direct route from Cincinnati to Columbus.

CINCINNATI, OHIO.—The Cincinnati, Newport & Alexandria Traction Company has been organized by A. S. Berry, John Todd, James C. Wright, A. R. Brothers, John Fromholtz, J. L. Thurner and Frank Thatcher. It is the intention to build a line to Alexandria, Ky. Surveys are being made.

DAYTON, OHIO.—The Gem City Street Railway Company is being organized by local people to build a street railway line from the Monument in North Main Street to the Davis Sewing Machine Company's factory and over a circuitous route embracing South Park, whose street car facilities are wholly inadequate.

BELLAIRE, OHIO.—Theodore Neff, of Bellaire, is said to be negotiating to build a line from Bellaire to Marietta, 90 miles; from Bellaire to St. Clairesville, 12 miles; from Carlington to Barnesville, 28 miles, and from Bellaire to Barnesville, 28 miles. Rights of way over considerable portion of the route have been secured.

CHILLICOTHE, OHIO.—The Chillicothe Electric Street Railway, Light & Power Company has closed an option on a six acre site for a power-house. The present station is inadequate and inconvenient and the intention is to erect a station near the center of distribution and convenient to a railroad. A car house will also be erected.

SPRINGFIELD, OHIO.—The Dayton & Kenton Traction Company is planning to build a branch line from New Carlisle to Springfield, thus making a through line from Dayton to Springfield. It is claimed that the route between the two cities will be shorter than that of the Dayton, Springfield & Urbana Railway and that there will be competition between the two lines.

TOLEDO, OHIO.—An issue of $50,000 in receiver's certificates on the Lake Shore Electric Railway has been sold in Toledo and Detroit. The certificates pay 6 per cent interest and are due Jan. 1, 1903. They are prior liens over even first mortgage bonds and there was no difficulty in placing them. The money obtained is being used for pressing improvements to the property.

COLUMBUS, OHIO.—The Columbus, Delaware & Sunbury Railway Company has been incorporated, with $10,000 capital stock. The road is to extend from Delaware to Sunbury by way of Berkshire, a distance of nine miles, and it is to be used as a feeder for the Columbus, Delaware & Northern Traction Company, the same capital and the same people being back of the project.

DAYTON, OHIO.—The Chase Construction Company of Detroit has established construction headquarters in the Eaker Building, this city. The company is building the Dayton, Covington & Piqua Railway, the Muncie, Hartford & Ft. Wayne Railway and the Dayton & Troy Railway, the latter being practically completed. Several miles of track have just been laid on the Covington line.

PORT CLINTON, OHIO.—Work is to be resumed in near future on the Tiffin-Port Clinton Railway. The project has been financed by the Kerlin Brothers, of Toledo, and the line will touch Tiffin, Fremont, Port Clinton and Lakeside. A power house wil be established at Port Clinton. This is a distinct project from the Central Ohio Railway Company, which is building between Tiffin and Fremont.

CINCINNATI, OHIO.—At the annual meeting of the Northern Ohio Traction H. A. Everett was elected president to succeed E. W. Moore. Will Christie, of Akron, vice-president; J. R. Nutt, Cleveland, treasurer; C. F. Moore, Akron, secretary; Charles Currie, Akron, general manager. As the property is paying well it is thought it will not be sold by the committee settling the Everett-Moore affairs.

FOSTORIA, OHIO.—It seems quite probable that the Ohio Northern Railway from Fostoria to Jerry City will be built this summer. Plans are being prepared for the details of the road. The line between the two towns will be thirteen miles long and there will be a three-mile loop connecting all the passenger stations in Fostoria. The road will pass through a thickly settled farming section and will form a through connection from Fostoria to Toledo. William D. Marks is president of the company.

TOLEDO, OHIO.—It is announced that the litigation pending for some time between the Toledo Railways & Light Company and the former owners of the Toledo & Maumee Valley Railway has been practically settled. The basis of the settlement has not been announced, but it is understood that the former Maumee Valley people have agreed to pay a stipulated sum in settlement of all claims. It is said that the purchase of the Maumee belt line was an excellent investment and that it has enhanced the value of the Toledo Railways & Light Company's property to a considerable extent.

AKRON, OHIO.—There is considerable speculation as to what the Tucker-Anthony syndicate will do with the right of way for the Canton, Massillon & Akron Railway which was included in the properties recently purchased from the Everett-Moore syndicate. The right of way was purchased in order to make it impossible for a competing line for the Canton-Akron Railway now nearly completed. The right of way is Y-shaped, including nearly 30 miles of private property, about 13 miles of it graded. The property was purchased outright and the farmers who sold it would not pay anything like the price they received to get the land back.

CLEVELAND, OHIO.—The transfer of the control of the Cleveland Electric Railway Company to the syndicate headed by Horace Andrews was effected March 8. Mr. Andrews handed to Chairman Newcomb, of the bankers' committee, a check for $3,545,000, and received orders for 43,000 shares of the Cleveland Electric and 1000 shares of Cleveland City. Immediately after the transfer a meeting of the Cleveland Electric Railway Company was held. Mr. Andrews was elected president; Henry J. Davis, secretary of the National Carbon Company, secretary, vice Fred S. Borton. Vice-President Harmon and Treasurer George S. Russell continue. It is probable that the companies will be consolidated.

NEW CASTLE, PA.—The New Castle & Sharon Electric Railway Company has let the contract to William McIntyre & Sons, of Sharon, for the erection of a $10,000 power house and sub-station at New Bedford, this county.

CHARLESTON, S. C.—A movement has been on foot for some time to build an electric railway to Summerville. Now the Magnolia Electric Railway, Light & Power Company, of Summerville, has applied for a charter for this purpose. The capital stock is placed at $5,000 with the privilege of increasing to $1,000,000. The applicants are all of Troy, Ohio, and are Chas. N. Burns, J. L. Brump, Robt. J. Smith and Gilmer T. Thomas.

CHATTANOOGA, TENN.—The operation of a second rapid transit railway has been inaugurated to the foot of Lookout Mountain. The Chattanooga Electric Railway Company promises to build up the mountain but has yet taken no steps in that direction.

NASHVILLE, TENN.—The Nashville & Columbia Electric Railway has been chartered by Frank P. Bond, Joseph Fulcher, Chas. W. Ruth and others. The capital stock is $50,000. The company proposes to build an electric road from Nashville to Mt. Pleasant.

NASHVILLE, TENN.—Local capitalists have under consideration a scheme for constructing an electric railway from Nashville to Lewisburg through Williamson County into Marshall County. It is reported that Edgar M. Jones, President of the Union Bank & Trust Company, is interested.

SAN ANGELO, TEX.—The San Angelo Rapid Transit Company has been organized at San Angelo, with a capital of $10,000. Incorporators: J. J. Nussbaumer, A. S. Grant, A. J. Morgan, C. H. Powell. The object is to provide transportation by automobiles for passengers and U. S. mail with adjacent towns.

HAMPTON, VA.—Engineer R. T. Pierce has just completed a survey of the route of the electric railway to be constructed from Jamestown, Va., through Williamsburg and Yorktown to Hampton. The line will be thirty-seven miles in length.

RICHMOND, VA.—The House has passed a bill to incorporate the Richmond Electric Railway Company. The bill provides for the promotion of an electric light, power or heat business in Richmond and adjoining territory. The incorporators are Dr. C. Archer, C. P. E. Burgwyn, R. B. Chaffin, W. B. Frayser, R. H. Nelson, J. W. Reams, Franklin Stearns and J. W. Turner.

TACOMA, WASH.—An electric railway is to run from the Great Northern road at Rock Island, Wash., to Waterville and Buckingham. Power is to be derived from Chelan Falls.

WHEELING, W. VA.—The Wheeling Traction Company will make extensive improvements to its power-house on Forty-second Street. Two 2000-hp engines, two 600-kw generators and two 500-hp boilers have been ordered and will be installed as soon as possible. A number of new cars will be ordered. The present transfer system will be improved and extended.

DEPERE, WIS.—At a recent meeting of citizens a franchise for an electric street railway was considered. The franchise was presented by the Fox River Electric Railway Company.

SHEBOYGAN, WIS.—J. M. Seaman is preparing to resume work on his interurban line between this city and Elkhart Lake, Plymouth and Waldo. The line to Elkhart Lake will be in operation by July 4.

LA CROSSE, WIS.—The La Crosse & Eastern Railway Company has been incorporated to acquire and operate a street, suburban and interurban railway to Viroqua. Several routes are already surveyed and construction upon it will begin in the spring. The incorporators of the company are Mayor Joseph Boschert, D. H. Palmer, J. B. Taylor, J. P. Reeve and E. C. Highbee.

THE AUTOMOBILE.

BIDS WANTED FOR AUTOMOBILES.—Recently the Cleveland Board of Public Works advertised for bids for the operation of an automobile bus line through the boulevards and park system of the city. Thus far not a single concern has presented a bid and the city has decided to advertise again.

NEW INDUSTRIAL COMPANIES.

THE UNION ELECTRIC MANUFACTURING COMPANY has been incorporated at Milwaukee, Wis., with a capital of $50,000.

THE POTENTIAL ELECTRIC COMPANY has been formed in New York City by A. C. Reeves, James Smith and Andrew Hunter. The capital is $1,000.

THE BUCKEYE ENGINE COMPANY has been incorporated in Jersey City, N. J., by Horace S. Gould, John I. Billings and K. K. McLaren. Capital stock, $1,000,000.

THE ELECTRIC MOTOR COMPANY OF AMERICA, of East St. Louis, Ill., capital $100,000, has been incorporated by Wallace Delafield, Jr., A. D. Scott, and Maurice E. Breed.

THE MASSENA ELECTRIC STEEL COMPANY, of Syracuse, N. Y.; capital, $500,000, has been incorporated. Directors: M. R. Conley, D. P. Fackor and T. T. Seeley, New York City.

THE PEERLESS ELECTRIC COMPANY, of New York, has been incorporated with a capital of $2,500. The directors are Jesse M. Yount, W. M. Yount and A. G. Kilmer of New York.

THE CONSOLIDATED WIRELESS TELEGRAPH & TELEPHONE COMPANY was recently incorporated in Phoenix, Ariz., by M. Van Booskirk, M. McEntee and others. The capital stock was placed at $25,000,000.

THE J. LANG ELECTRIC COMPANY has been incorporated in Chicago with a capital stock of $15,000 to manufacture electrical machinery and apparatus. The incorporators are Walter D. Hawk, Robert D. Dunn and Warren Ripple.

LEGAL.

AMERICAN ALKALI TROUBLES.—Charging fraud, four stockholders of the American Alkali Company have filed a bill in the United States Circuit Court at Trenton, N. J., asking that the company be dissolved and its affairs wound up. The company was organized in New Jersey in April, 1899, with a capital stock of $30,000,000, divided into 480,000 shares of common stock and 120,000 shares of preferred stock at a par value of $50 each. The charge is made by Winfield S. Campbell, Washington Righter, David S. Thompson and W. Paul Subers, of Philadelphia. Campbell owned 5,100 shares, Righter 100 shares, Subers 20 shares, and Thompson 8,700 shares of preferred stock. The latter also held 700 shares of common stock. Soon after the incorporation of the company it organized the Canadian Electro-Chemical Company, Limited, through which it established at Sault Ste. Marie, Canada, a plant, expending therefor $246,142.59, which plant was put in operation in January, 1901, and continued until Sept. 25, 1901. The bill prays that the company may be enjoined from prosecuting assessment suits and from further prosecuting the business, except to preserve its assets and wind up the business. The patent rights under which the American Alkali Company first operated were originally secured for the United States and Canada by Hermite & Dabose and John C. A. Rhodin. The company's office is at 815 Drexel Building, Philadelphia, and its management is in the hands of the following officers: W. W. Gibbs, president; F. H. Clergue, vice-president and general manager; George Philler, second vice-president; Clayton E. Platt, secretary and treasurer. The board of directors is composed of W. W. Gibbs, F. H. Clergue, George Philler, Samuel R. Shipley, Dr. Herbert M. Howe, W. M. Kerr and Ernest E. Davies.

OBITUARY.

WILLIAM LOHMILLER, one of the best known independent telephone men of the Northwest, died recently at La Crosse, Wis., aged 58. He was secretary of the La Crosse Telephone Company and director of the Wisconsin Independent Telephone Association for many years.

LIEUT. PAUL D. STOCKLY.—It is announced from Washington that the name of Second Lieutenant Paul D. Stockly, Twenty-first Infantry, has been ordered stricken from the army rolls. The officer is now officially dead. On January 12, 1901, Stockly disappeared while stationed in the Philippines, and since that time no trace of him has been found. It is thought that he was murdered by the Filipinos. Lieutenant Stockly was the son of George W. Stockly, president of the Sims-Dudley Arms Company, and well known for years as the forceful president of the old Brush Electric Company, of Cleveland. Mr. Stockly has exhausted every means to discover his son's fate. Young Stockly went to the front in the Philippines with a dynamite gun battery and was very reckless while on the firing line, so that there is little doubt that he fell into an ambuscade or died in some hand to hand encounter. He was a most amiable and intelligent officer, and would have won distinction in any path in life. We can but record our own profound sorrow at his death, and join in the general sympathy with the bereaved family.

PERSONAL.

PRESIDENT R. C. CLOWRY.

COL. R. C. CLOWRY, of Chicago, as noted by us last week, succeeds General Eckert as president of the Western Union Telegraph Company, at a date not yet fixed, but in the near future. He was elected president and general manager at the last meeting of the directors. Col. Clowry, the new president, has filled positions with the Illinois and Mississippi, the Missouri and Western and the Western Union telegraph companies as messenger, operator, manager, superintendent, general superintendent and vice-president successively. At the beginning of the Civil War he was commissioned by President Lincoln as captain and assistant quartermaster and placed in charge of the United States military telegraphs in the Departments of Missouri, Kansas and Arkansas. At the close of the war he received a brevet commission as lieutenant-colonel from President Johnson for meritorious service and devoted application to duty. His name had already been mentioned more than once for the presidency of the corporation he has served so efficiently out West.

MR. G. G. WARD, president of the Commercial Cable Company, is making a long trip on the Pacific coast.

MR. ARTHUR WARREN, of the British Westinghouse Electric Company, is due in New York this week from England.

MR. CARYL D. HASKINS read a paper before the Franklin Institute, Philadelphia, March 20, entitled "Electrical Measuring Instruments."

MR. A. FREDERICK COLLINS gave a demonstration on wireless telegraphy at the Baron de Hirsch Trade School, New York, on the evening of March 12.

MR. E. H. R. GREEN, president of the Texas Midland Railroad, is working on wireless telegraphy and taking out patents. He will apply the system to his own road.

MR. R. E. T. PRINGLE, of Montreal, Can., has informed us that the business heretofore carried on by himself will hereafter be conducted by a Canadian corporation to be known as the R. E. T. Pringle Company, Limited.

MR. ARTHUR WILLIAMS has joined the ranks of the electrical editors, and is now issuing for the New York Edison Company a neat little monthly bulletin devoted to information concerning the company's work, customers, etc.

MR. W. ETENGER, of the telegraph department of the Pennsylvania Railroad Company at Jersey City, is working on the problem of getting all the wires underground between Jersey City and Philadelphia, between which points the road has 24 through wires.

MR. EDWARD H. COX, recently on the New York staff of the Electric Vehicle Company, has joined the technical and selling forces of the Automobile Company of America. For many years past, Mr. Cox has specialized on hydrocarbon engines, and on their application in automobile work brings to bear a vast amount of experience.

MR. THEODORE P. COOK, district superintendent of the Western Union Telegraph Company at St. Louis, Mo., has been tendered and has accepted the position of general superintendent of the Western Division, with headquarters at Chicago, to take effect on April 1, in the place of Col. R. C. Clowry, recently elected president and general manager.

MR. BERNARD DRAKE, of Drake & Gorham, the well-known English electrical engineers and contractors, is now in America looking around and getting posted on the industrial situation. It is some 20 years since Mr. Drake was last over here, and since that time he has done a lot of good pioneer work in the introduction of electrical inventions. He returns to London this week.

MR. R. PERCY SELLON, of the Brush Electric Engineering Company, Limited, of England, is now on a trip to this country, which he has reached via the West Indies, where he and his wife have made a winter tour of recreation. Mr. Sellon is an active member of the English Institution of Electrical Engineers and English official bodies interested in standardization of apparatus, and while here is studying up the work done by the American Institute of Electrical Engineers in that direction.

MR. U. N. BETHELL, the general manager of the New York Telephone Company, the Chesapeake & Potomac Telephone Company, etc., has just been admitted to practice in the United States Supreme Court. He was presented for admission by ex-Attorney-General Griggs, who is said to be likely to fill the vacancy on the Supreme Court bench. Mr. Bethell began his study of law while a government clerk in Washington, and has already practised in the Supreme Court of the District of Columbia.

MR. F. A. CROSELMIRE, well known in the electrical trade, has associated himself with Mr. W. F. Ackor, in the gold, silver and platinum business, under the firm name of Croselmire & Ackor. Having been associated many years in the same line of business with his father, Mr. C. F. Croselmire, and who has retired, he brings to the new firm the experience of years. The new firm has just completed one of the most modern and up to date plants, with all the latest and most modern machinery for working platinum in any shape or form.

MR. CHARLES C. MARTIN, consulting engineer of the New York department of bridges, was tendered a complimentary dinner on the evening of Saturday, March 15, by the citizens of Brooklyn in recognition of Mr. Martin's long devotion to the public good in his intelligent and upright administration of the affairs of the Brooklyn Bridge from its design to the present day. During his long period of office as chief engineer of the bridge he has had many electrical problems to solve relating to lighting and traction. A pleasant feature of the evening was the presentation of a bronze statue of David to the guest of honor.

Trade Notes.

CORRESPONDENCE SCHOOL WORK.—Mr. Frank O. Hubbard, of Chicago, recently completed the stationary engineering course in the American School of Correspondence and received his diploma. Mr. Hubbard is an electrician with Marshall Field & Co.

THE ELECTRIC APPLIANCE COMPANY, Chicago, distributing agent for the Gutmann alternating current integrating wattmeters, is at last, through increased facilities at the factory, able once more to fill orders promptly. The rush of business which caught it unawares was something that no foresight could anticipate.

BULLOCK APPARATUS.—The Bullock Electric Manufacturing Company, Cincinnati, Ohio, has recently issued a folder giving illustrations of various types of its generating apparatus, and power motors. Among the machines shown is a three-phase generator installed at Shiek's Island, Canada, which plant was described quite fully in these columns March 1.

PERKINS SWITCHES.—The principal office and the entire manufacturing department of the Perkins Electric Switch Manufacturing Co., Hartford, Conn., located at that city, have been removed to Bridgeport, Conn., and hereafter all correspondence should be addressed to 1421 State Street, in the latter city. The addresses of the New York and Chicago offices remain the same as now.

THE METROPOLITAN SWITCHBOARD COMPANY, New York, announces that, owing to the increase in the amount of work, it has been compelled to secure more space, and has therefore removed its factory and office to 227 West 29th Street. Mr. T. J. Murphy, the proprietor of this business, opened the new quarters on March 17, and presented every caller on that day with a green souvenir.

THE BURT MANUFACTURING CO., of Akron, O., has issued two very neat little booklets describing its Cross oil filter and the Burt exhaust head, copies of which will be mailed to any one upon application. It may be mentioned here that this filter was awarded the highest medal at the Pan-American Exposition and that its sale has extended to 28 different countries while nine governments have adopted it for use in their navies, arsenals, etc.

THE CINCINNATI MILLING MACHINE CO., Cincinnati, O., has just issued a new 1902 catalogue showing its new line of milling machines. This is a very handsome piece of book work, the illustrations being in half-tone throughout. A number of interesting improvements are illustrated and described in detail, including the company's new all-gear feed mechanism, whereby all feed changes are instantly obtained by movement of the lever, the drive being always positive, permitting much heavier and faster cuts than the old belt-fed mechanism.

CHARLES H. BESLY & CO., No. 10-12 N. Canal Street, Chicago, Ill., report their general business very good. They are receiving many orders for their celebrated Gardner grinder with spiral grooved discs; recent shipments being made to California, Washington, Oregon, Wisconsin, Ohio and Pennsylvania. They are also receiving many orders from the Pacific Coast for their Helmet oil, Badger and Bonanza cups. The late edition of Charles H. Besly & Co.'s general catalogue with discount sheet will be mailed free to any address upon application.

CEDAR PRODUCTS.—The C. H. Worcester Company, Marinette, Wis., has compiled a complete telegraph code suitable for the requirements of buyers and sellers of white cedar products, and published the same in a pamphlet of 16 pages. The Northwestern Cedarmen's Association standard specifications of white cedar products are also included, together with other valuable information on the subject. The C. H. Worcester Company is producer and wholesaler of Michigan white cedar telegraph poles, railway ties, etc., and has 12 branch yards in Michigan and Wisconsin.

MULTIPOLAR DYNAMOS.—In its Bulletin No. 160 the Jenney Electric Manufacturing Company, Indianapolis, Ind., describes and illustrates with a large number of excellent cuts, its line of multipolar dynamos. The many illustrations in detail and accompanying description bear out the claim made that these machines embody the most modern ideas of dynamo construction. There are four general types, viz., slow-speed belt-driven generators ranging in capacity from 1 to 250 kilowatts; intermediate-speed belt-driven generators ranging from 4.6 to 225 kilowatts; moderate-speed belt-driven generators ranging in capacity from 75 to 150 kilowatts, and direct-connected generators ranging from 7½ to 125 kilowatts.

THE WESTERN ELECTRICAL SUPPLY COMPANY, of St. Louis, reports that it is anticipating an extremely heavy demand for supplies and construction material in spring work. It has laid in one of the heaviest stocks on record. It is prepared to furnish promptly from St. Louis stock, a complete line of wires and cables, cross arms, cross arm braces, insulators, construction tools of every description, overhead material for electric railways and, in fact, everything pertaining to outside electrical construction. It is also carrying a very large stock of rubber covered wires and cables, conduit and fittings, outlet and switch boxes and kindred material. The company states the outlook for a large increase in electrical construction of every description for the coming year is the best ever known. It issues a very complete line of catalogues, etc., which will be mailed on application.

SMALL MOTORS.—With this title the General Electric press has issued a 64-page pamphlet profusely illustrated and printed on an excellent quality of half-tone paper, the size of page being 8½ by 10 inches. A very interesting section is devoted to General Electric motors for operating machine tools, which contains illustrations of more than a score of tools fitted with electric drive. Other sections are on belted motors, special motors, special applications of motors, motors for automobiles, and small alternating-current motors, single and polyphase. The designs of the section title pages are extremely effective, and the cover design is a work of art, though unfortunately marred in effect by the color of the cover paper. The pamphlet forms a treatise on small motors of considerable technical value. Much of the text would have been welcomed by technical journals for use in their columns.

FANS DOWN SOUTH.—Newman-Spranley Company, Ltd., New Orleans, reports a great boom in all departments, particularly in electrical apparatus. Having sold over 30 Diehl motors and dynamos during the past month, it states that while cities in the North were snow bound, it was enjoying balmy weather and sold a good many fans. It has taken the agency for the full line of goods manufactured by the Diehl Manufacturing Company, Elizabethport, N. J. A shipment of its stock order has been received consisting of six carloads. This quantity is without dispute the largest ever made to any concern in the world and reflects great credit on the business ability of the Newman-Spranley Company, who anticipated an increasing demand for good fans and made preparations to meet it. This six-carload shipment included an assortment of both types of ceiling, 2 and 4-blade, electroliers, column, electrolier column, in ten designs and all finishes; also desk, bracket, trunnion and universal joint desk in three sizes, 9, 12, and 16-inch. This makes not only the largest shipment, but the greatest assortment of fans to select from, which fact will be appreciated by its patrons.

STOKERS FOR HALF A MILLION HORSE-POWER.—The list of recent installations of Roney mechanical stokers, which has just been compiled by Westinghouse, Church, Kerr & Co., goes far toward substantiating their claim that such apparatus forms a part of the equipment of most of the modern steam plants in which a high standard of engineering has been adopted. The list starts with the four large organizations upon which New York City depends for its lighting and transportation service; namely, New York Edison Company, Metropolitan Railway Company, Third Avenue Railway Company (now controlled by the Metropolitan) and the Manhattan Railway Company. These plants aggregate 128,500 horse-power boiler capacity fitted with Roney mechanical stokers. Lighting, street railway and industrial concerns throughout the country, swell the aggregate to a round half-million horse-power. The list is thoroughly representative of industries using power and includes central station and isolated electric lighting plants, street railway power houses, steam railroad shops and terminal stations, refineries, chemical works, cotton, woolen and silk mills, mining, smelting and refining plants, paper and flour mills and large manufacturing companies of every description.

Record of Electrical Patents

UNITED STATES PATENTS, ISSUED MARCH 11, 1902.

[Conducted by Wm. A. Rosenbaum, Patent Attorney, 140 Nassau St., New York.]

694,425. ELECTRIC RAILWAY SYSTEM; John Ryan, Watertown, N. Y. App. filed Oct. 8, 1900. A sectional electric railway system employing two sectional conductors, one of which is between, and the other, outside, the track. The car carries a storage battery to regain the power current if broken. Connected with each pair of sectional conductors is a pair of solenoidal switches which close the car supply circuit when a car is over a section.

694,946. METHOD OF COVERING TEXTILE AND POROUS MATERIALS WITH METAL; J. A. Daly, Washington, D. C. App. filed Aug. 30, 1900. (See Current News and Notes.)

694,977. ELECTRIC SWITCH; R. C. Moore, Kansas City, Mo. App. filed March 1, 1901. A selective device for party line and similar service involving a modification of the step by step ratchet switch device.

694,989. INSULATED COMPOUND; H. N. Potter, Gottingen, Germany. App. filed Aug. 9, 1899. Consists of soapstone or talc-powder and water combined with a binder such as tragacanth.

694,991. ELECTRIC IGNITER; C. C. Reid, Cleveland, Ohio. App. filed Nov. 30, 1901. Details of a sparking device.

694,999. DYNAMO-ELECTRIC MACHINE; C. P. E. Schneider, Le Creusot, France. App. filed Oct. 11, 1901. Caps of magnetic material are secured to armature teeth and extend to close wholly or partially the slot opening, thereby facilitating armature winding and securing practically the advantages of a tunnel winding.

695,033. PRODUCTION OF CHLORIN AND ALKALINE HYDRATES ELECTROLYTICALLY; E. D. Chaplin, Winchester, Mass., and H. G. Halloran, Boston, Mass. App. filed April 26, 1900. (See Current News and Notes.)

695,049. BURGLAR ALARM FLY SCREEN; D. S. Hill, Cincinnati. Ohio. App. filed May 1, 1901. The screen is under tension and when the tension is altered by tampering, certain contacts are allowed to come together and close an alarm circuit.

695,105. TELEPHONE SUB-STATION REGISTERING SYSTEM; J. D. Hobbs, Jersey City, N. J. App. filed Jan. 26, 1901. (See page 514.)

695,118. CONTROLLER FOR ELECTRIC MOTORS; R. H. Read, Schenectady, N. Y. App. filed July 26, 1901. Tubes conveying air under pressure are directed towards the several contacts of the controller and blasts of air are directed across the contacts at the moment when the circuit is broken, to disrupt the arc.

695,122. SIGNAL SYSTEM FOR ELECTRIC RAILWAYS; C. B. Stewart, Jr., Schenectady, N. Y. App. filed May 13, 1899. A visual signal automatically shows when the exposed working conductor is charged.

695,127. INSULATED CONDUCTOR; E. Thomson, Swampscott, Mass., and J. G. Callan, Lynn, Mass. App. filed Nov. 7, 1901. (See Current News and Notes.)

695,134. CIRCUIT BREAKER; C. C. Badeu, Schenectady, N. Y. App. filed July 25, 1901. The tripping armature is provided with an auxiliary magnetic field of sufficient density to overcome the friction of the moving parts, which renders the armature free to respond to a smaller excess of current than when such friction must be overcome by the load current.

695,143. ELECTRIC METER; T. Bruger, Frankfort-on-the-Main, Germany. App. filed Nov. 29, 1901. An electric meter, comprising a plurality of conducting systems connected in parallel, each system including an active coil and a resistance connected by a collector-segment arranged between the resistance and active coils, the resistances being connected at a common point, with means for supplying current at said common point of connection.

695,144. ELECTRIC BRAKE; F. E. Case, Schenectady, N. Y. App. filed April 4, 1898. After the controller handle cuts off the current, it engages with contacts which start a brake applying motor. This motor acts through a worm gear so that after the brakes have been set, the current may be turned off without releasing the brakes.

695,150. ELECTRIC SWITCH; C. D. Haskins, Schenectady, N. Y. App. filed July 27, 1901. Provision for permitting a flow of oil under pressure across the separating contacts to extinguish the arc.

695,163. FIELD MAGNET FOR DYNAMO ELECTRIC MACHINES OR ELECTRIC MOTORS; R. Lundell, New York, N. Y. App. filed Dec. 18, 1901. A supporting-frame for a laminated field-magnet, consisting of two end brackets with connecting-pieces between them, the frame being absolutely rigid by itself when bolted together.

695,188. KNIFE SWITCH; J. A. Wright and W. O'Neill, Wilkinsburg, Pa. App. filed July 12, 1901. A double switch blade bulged in opposite directions at its handle end and having a projection which enters a notch in the handle, affording a rigid connection between the blade and handle.

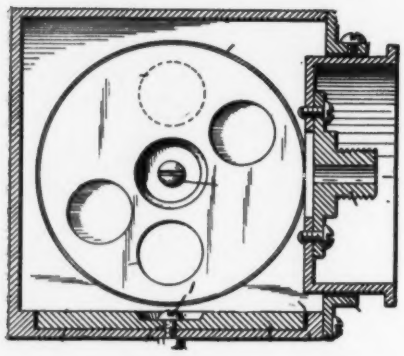
695,203. AUTOMATIC TELEGRAPH; A. C. Gilmore, Chicago, Ill. App. filed April 22, 1901. The apparatus includes separate electrical devices relatively quick and slow acting to respond differently to variably timed current impulses of signal code combinations, and selector mechanisms arranged to be variably actuated by said devices into position to make the signal corresponding to the combination of impulses received.

695,220. ELECTROMECHANICAL WATER WHEEL GOVERNOR; L. Lyndon, New York, N. Y. App. filed Sept. 13, 1900. (See Current News and Notes.)

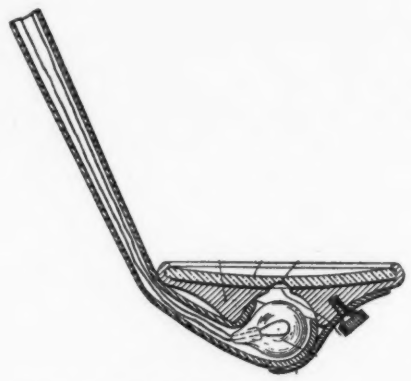
695,243. ELECTRIC JUNCTION OR OUTLET BOX; J. H. Stahley, New York, N. Y. App. filed Jan. 17, 1902. A disc having openings in it is pivoted against the wall of the box so that it may be turned either to cover the openings in the box or expose them.

695,245. ALARM ATTACHMENT FOR INCUBATORS; R. H. Stevenson, Jr., Western Springs, Ill. App. filed May 4, 1901. Details.

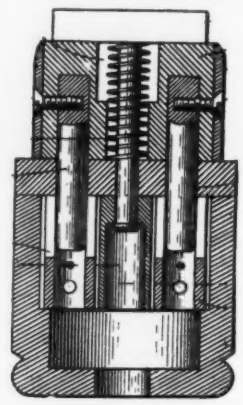
695,253. ELECTROMAGNETIC ENGINE; P. B. Watson, Philadelphia, Pa. App. filed May 28, 1901. Electromagnets and a fly wheel set up on the plan of a reciprocating engine.



695,243.—Electric Junction or Outlet Box.



695,338.—Combined Light and Mirror.



695,366.—Combination Plug Switch.

695,260. TELEPHONE AND FIRE ALARM SIGNAL; L. G. Woolley, Kenton, Ohio. App. filed Dec. 28, 1899. (See page 515.)

695,268. TELEPHONE RECEIVER SUPPORT; G. M. Beerbower, New York, N. Y. App. filed May 27, 1901. (See page 515.)

695,302. APPARATUS FOR THE ELECTROLYTIC DECOMPOSITION OF ALKALINE SALTS; J. D. Gilmour, Glasgow, Scotland. App. filed April 29, 1901. (See Current News and Notes.)

695,308. LAMP HANGER; H. J. Harrison, Juneau, Alaska Ter. App. filed Sept. 5, 1901. Details.

695,338. COMBINED LIGHT AND MIRROR; G. J. Paynter and F. C. Watson, Philadelphia, Pa. App. filed Aug. 7, 1901. An incandescent lamp is seated in a cavity in the back of a dental mirror and shines through a small transparent portion of the center of the mirror.

695,358. MAGNETO ELECTRIC GENERATOR; J. M. Wilson, Battle Creek, Mich. App. filed April 27, 1901. A rotating field-magnet is driven through a friction clutch interposed between the driving pulley and the magnet structure. Centrifugal force acting on the clutch regulates the speed of the field-magnet.

695,366. COMBINATION PLUG SWITCH; J. I. Ayer, Malden, Mass. App. filed Sept. 20, 1901. A compound plug switch having means for preventing the shifting of the switch or changing the contact connections for different combinations while the main supply current is in active circuit therewith.

695,383. MAGNETIC TRACTION; S. A. Gibbs, Tacoma, Wash. App. filed June 19, 1901. Magnets carried by an engine have their poles presented closely to the rails to increase the tractive force of the engine.

695,398. CIRCUIT MAKER FOR ELECTRIC FIRE ALARMS; F. W. Jordan, Norwood, Mass. App. filed July 19, 1901. A lever is connected with a wiring moulding in such a way that it is normally in contact with one of the wires and held out of contact with the other by a fusible block. A fire melts the block and permits the lever to make contact with both wires of the moulding and thus establish a short circuit.